FINAL
RECORD OF DECISION/REMEDIAL ACTION PLAN
OPERABLE UNIT 1A
FORMER MARINE CORPS AIR STATION
TUSTIN, CALIFORNIA

OCTOBER 2004

DECLARATION

DECLARATION

SITE NAME AND LOCATION

Site Installation Restoration Program (IRP)-13S, Temporary Storage Area No. 72 (ST-72) and Miscellaneous Wash Area No. 18 (MWA-18) – Operable Unit (OU)-1A

Former Marine Corps Air Station (MCAS) Tustin
Orange County, California

National Superfund Database Identification Number: CA9170090022

STATEMENT OF BASIS AND PURPOSE

This final Record of Decision (ROD)/Remedial Action Plan (RAP) presents the selected remedial action for groundwater at OU-1A Site IRP-13S at Former MCAS Tustin, located in Orange County, California.

This document was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (42 *United States Code* Section [§] 9602 et seq.) and in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (Title 40 *Code of Federal Regulations* § 300 et seq.). The decision for this site is based on information contained in the administrative record. A site-specific administrative record index for IRP-13S is included as Attachment A.

The California Environmental Protection Agency Department of Toxic Substances Control (DTSC), the Regional Water Quality Control Board Santa Ana Region, and the United States Environmental Protection Agency concur on the selected remedy.

REMEDIAL ACTION PLAN

This ROD/RAP satisfies the DTSC requirements for a RAP for hazardous substance release sites pursuant to *California Health and Safety Code* § 25356.1. The RAP requirements are summarized in Attachment C.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from groundwater at IRP-13S, if not addressed by implementing the remedial action selected in this ROD/RAP, may present a potential threat to public health and welfare or to the environment.

DESCRIPTION OF THE REMEDY

The impacted medium at IRP-13S is groundwater. The chemicals of concern (COCs) in groundwater are volatile organic compounds (VOCs).

Risks due to contaminated soil at IRP-13S were evaluated during the remedial investigation and feasibility study. The feasibility study recommended no further action for soil at IRP-13S, since the contaminated soil does not pose a significant risk to human health and the environment. However, limited soil removal would further enhance contaminant mass removal, lessen the time needed to achieve remedial action objectives, and remove a potential continuing source of trichloroethene to groundwater resulting in concentrations exceeding the maximum contaminant level. Therefore, the selected remedy includes excavation and off-site disposal of soil hot spots (the most highly contaminated source areas). The selected remedy for groundwater at IRP-13S includes:

- construction, operation, and maintenance of a groundwater extraction and treatment system to reduce elevated (i.e., hot spot) concentrations of VOCs in groundwater and to prevent or limit VOC migration beyond the current OU-1A plume boundaries (stabilize the plume);
- groundwater extraction using extraction wells located in the hot spot areas of the plumes and hydraulic containment wells located on the margin of the plumes;
- treatment of extracted groundwater and either discharge of the treated groundwater to a nearby storm drain or disposal by another method based on a reevaluation of disposal options to be conducted during the remedial design phase;
- excavation and off-site disposal of VOC-contaminated soil to reduce the amount of this material, which could potentially act as an ongoing source of residual contamination to groundwater;
- performance monitoring throughout the remedial action;
- confirmatory groundwater sampling at the end of the remedial action to confirm that VOC concentrations have met remediation goals;
- protection of the integrity of groundwater extraction wells and remediation equipment;
- prevention of inadvertent use of or exposure to contaminated groundwater; and
- allowing the Department of the Navy (DON), DON contractors, and regulatory personnel access to install, operate, and maintain remediation equipment and to monitor the remedial action.

Extracted groundwater will be pumped through a cartridge filtration system followed by two-stage granular activated carbon adsorption. When the activated carbon in a canister becomes saturated with VOCs and is no longer effective, it will be replaced with new carbon. The saturated carbon then will be returned to the manufacturer, where it will be regenerated and the VOCs destroyed. Contaminated soil that is excavated will be transported to a permitted off-site disposal facility. Clean fill will be used to backfill the excavated area.

The remedial action addresses the risk posed by VOC contamination in groundwater (which has been characterized as the primary threat at this site) by removing and permanently destroying the contaminants, thereby significantly reducing the toxicity, mobility, and volume of hazardous substances in soil and groundwater.

Institutional controls in the form of lease restrictions (if the property is leased) or restrictive covenants (if the property is transferred by deed) will be used to protect the integrity of the groundwater extraction wells and remediation equipment. Institutional controls are also necessary to prevent inadvertent use of contaminated groundwater and to allow the DON, DON contractors, and regulatory personnel access to install, operate, and maintain equipment and to monitor the remedial action.

The proposed alternative in the Proposed Plan included thermal treatment and reuse of the soil for the soil disposal component. Since the Feasibility Study Report and Proposed Plan were issued, this approach has been determined to be infeasible, and off-site disposal has been included in the selected remedy. Section 12 provides the rationale for the change in the soil disposal component.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, and is cost-effective. The selected remedy uses permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable and satisfies the statutory preference for remedies employing treatment that reduces toxicity, mobility, and/or volume as a principal element.

The effectiveness of the selected remedial action discussed in this ROD/RAP will be reviewed at a minimum of 5 years to assure that it continues to provide adequate protection of human health and the environment and is achieving remediation goals. Once remediation goals have been achieved, the 5-year review will no longer apply to this action because hazardous substances will not remain above human-health-based levels.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary:

- COCs and their respective concentrations (Section 5)
- baseline risk represented by the COCs (Section 7)
- remediation goals established for COCs and the basis for these goals (Sections 8 and 10)
- how source material constituting principal threats is addressed (Section 8)
- current and reasonably anticipated future land-use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD/RAP (Sections 6 and 7)
- estimated capital, annual operation and maintenance, and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected (Section 10)
- key factors that led to selecting the remedy (Sections 8, 9, 10, and 12)

Additional information can be found in the administrative record files for this site.

Signature: ______________________________ Date: 12/22/04
Mr. Jerry Dunaway
Base Realignment and Closure Environmental Coordinator
Former Marine Corps Air Station Tustin

Signature: ______________________________ Date: 11/10/04
Mr. John E. Scandura, Chief
Southern California Operations
Office of Military Facilities
Department of Toxic Substances Control

Signature: ______________________________ Date: November 4, 2004
Mr. Gerard Thibeault, Executive Officer
California Regional Water Quality Control Board Santa Ana Region

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ACRONYMS/ABBREVIATIONS

ANL	Argonne National Laboratory
AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
BCT	BRAC Cleanup Team
BEI	Bechtel Environmental, Inc.
bgs	below ground surface
BNI	Bechtel National, Inc.
BRAC	Base Realignment and Closure
Brown and Caldwell	Brown and Caldwell Consulting Engineers
Cal. Civ. Code	*California Civil Code*
Cal. Code Regs.	*California Code of Regulations*
Cal/EPA	California Environmental Protection Agency
Cal. Health & Safety Code	*California Health and Safety Code*
CAMU	corrective action management unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	chlorofluorocarbon
C.F.R.	*Code of Federal Regulations*
ch.	chapter
COC	chemical of concern
COPC	chemical of potential concern
CSF	cancer slope factor
CTR	California Toxics Rule
CWA	Clean Water Act
DCE	dichloroethene
div.	division
DNAPL	dense nonaqueous-phase liquid
DON	Department of the Navy
DTSC	(Cal/EPA) Department of Toxic Substances Control
EIR	environmental impact report
EIS	environmental impact statement
EPC	exposure point concentration
ESI	expanded site inspection
Fed. Reg.	*Federal Register*
FFSRA	Federal Facility Site Remediation Agreement
Freon 112	1,1,2,2-tetrachloro-1,2-difluoroethane
Freon 113	1,1,2-trichloro-1,2,2-trifluoroethane
FS	feasibility study

GAC	granular activated carbon
gpm	gallons per minute
GSE	ground support equipment
HHRA	human-health risk assessment
HI	hazard index
HQ	hazard quotient
HUD	Department of Housing and Urban Development
IAS	initial assessment study
IRP	Installation Restoration Program
ISWP	Inland Surface Waters Plan
IT	The IT Group
JEG	Jacobs Engineering Group Inc.
JMM	James M. Montgomery Engineers, Inc.
LDR	land disposal restriction
LRA	Local Redevelopment Authority
LTA	lighter than air
LUC	land-use control
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
MCAF	Marine Corps Air Facility
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
mg/L	milligrams per liter
MICR	maximum individual cancer risk
MPE	multiphase extraction
MSL	mean sea level
MTBE	methyl tert-butyl ether
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NTR	National Toxics Rule
O&M	operation and maintenance
OHM	OHM Remediation Services Corp.
OMP	operation and maintenance plan
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit

PCAP	Petroleum Corrective Action Program
PR	preliminary review
PRMP	Paleontological Resources Management Plan
PTES	Pacific Treatment Environmental Services
RAB	Restoration Advisory Board
RAO	remedial action objective
RAP	remedial action plan
RCRA	Resource Conservation and Recovery Act
Res.	resolution
RFA	RCRA facility assessment
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
ROD	record of decision
RWQCB	(California) Regional Water Quality Control Board (Santa Ana Region)
§	section
SARA	Superfund Amendments and Reauthorization Act of 1986
SCAQMD	South Coast Air Quality Management District
SDWA	Safe Drinking Water Act
SI	site inspection
SIP	site implementation plan
SP	specific plan
SV	site visit
SVE	soil vapor extraction
SWDIV	Southwest Division Naval Facilities Engineering Command
SWRCB	(California) State Water Resources Control Board
T-BACT	best available control technology for toxics
TCA	trichloroethane
TCE	trichloroethene
TCP	trichloropropane
TCRA	time-critical removal action
TDS	total dissolved solids
TDU	thermal desorption unit
tit.	title
TSD	treatment, storage, and disposal
UCI	University of California, Irvine
UCL	upper confidence limit
USACE	United States Army Corps of Engineers
U.S.C.	*United States Code*
USDA	United States Department of Agriculture

U.S. EPA	United States Environmental Protection Agency
USMC	United States Marine Corps
UST	underground storage tank
VEE	vacuum-enhanced extraction
VOC	volatile organic compound
VSI	visual site inspection
WBZ	water-bearing zone
WQCP	water quality control plan
WQO	water quality objective

DECISION SUMMARY

Section 1
SITE NAME, LOCATION, AND DESCRIPTION

This Record of Decision (ROD)/Remedial Action Plan (RAP) presents the selected remedial action for groundwater at Operable Unit (OU)-1A, Installation Restoration Program (IRP) Site IRP-13S at Former Marine Corps Air Station (MCAS) Tustin in Orange County, California. The National Superfund Database Identification Number for Former MCAS Tustin is CA9170090022. This ROD/RAP satisfies the California Environmental Protection Agency Department of Toxic Substances Control (DTSC) requirements for a RAP for hazardous substance release sites pursuant to *California Health and Safety Code* (Cal. Health & Safety Code) Section (§) 25356.1.

This document was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The decision for this site is based on information contained in the administrative record. The site-specific administrative record index for OU-1A is provided in Attachment A.

1.1 SITE NAME

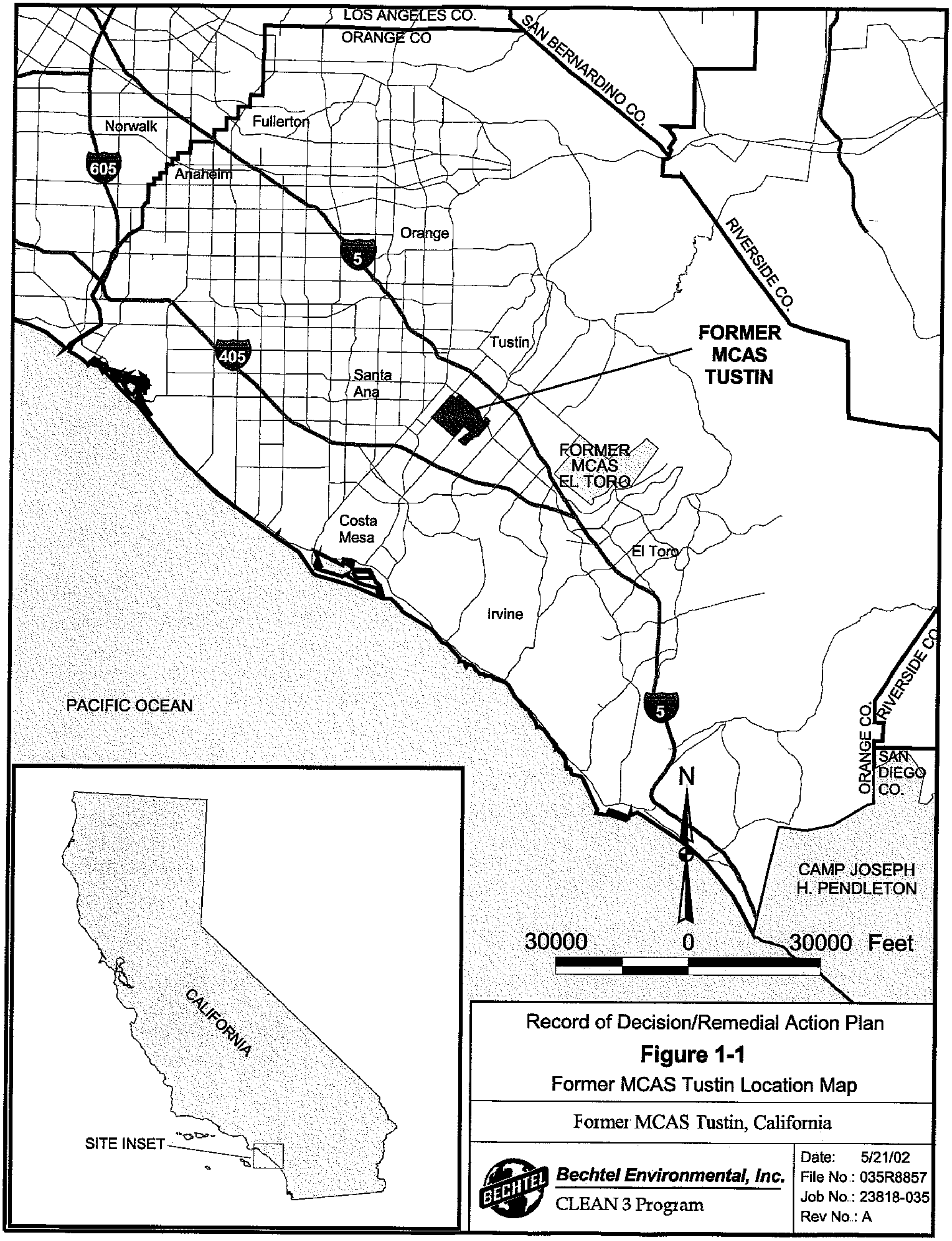
This decision document addresses groundwater at one site at Former MCAS Tustin: IRP-13S, consisting of Temporary Storage Area No. 72 (ST-72) and Miscellaneous Wash Area No. 18 (MWA-18). Groundwater is the only medium that presents a risk to human health at the site. Soil, however, is also being addressed as part of the groundwater remedy because of the potential for residual contaminants in soil to act as a continuing source of groundwater contamination.

1.2 SITE LOCATION

Former MCAS Tustin is located in southern California in Orange County, approximately 40 miles south of downtown Los Angeles and more than 100 miles north of the California-Mexico border (Figure 1-1). IRP-13S (OU-1A) is located in the northwest portion of the Former MCAS Tustin property (Figure 1-2).

1.3 LEAD AND SUPPORT AGENCIES

Former MCAS Tustin is not listed on the National Priorities List. A Federal Facility Site Remediation Agreement (FFSRA) between the Department of the Navy (DON) and the DTSC was signed for Former MCAS Tustin on 18 August 1999. The FFSRA defines the DON's corrective action and response obligations under the Resource Conservation and Recovery Act (RCRA) and CERCLA.



Record of Decision/Remedial Action Plan

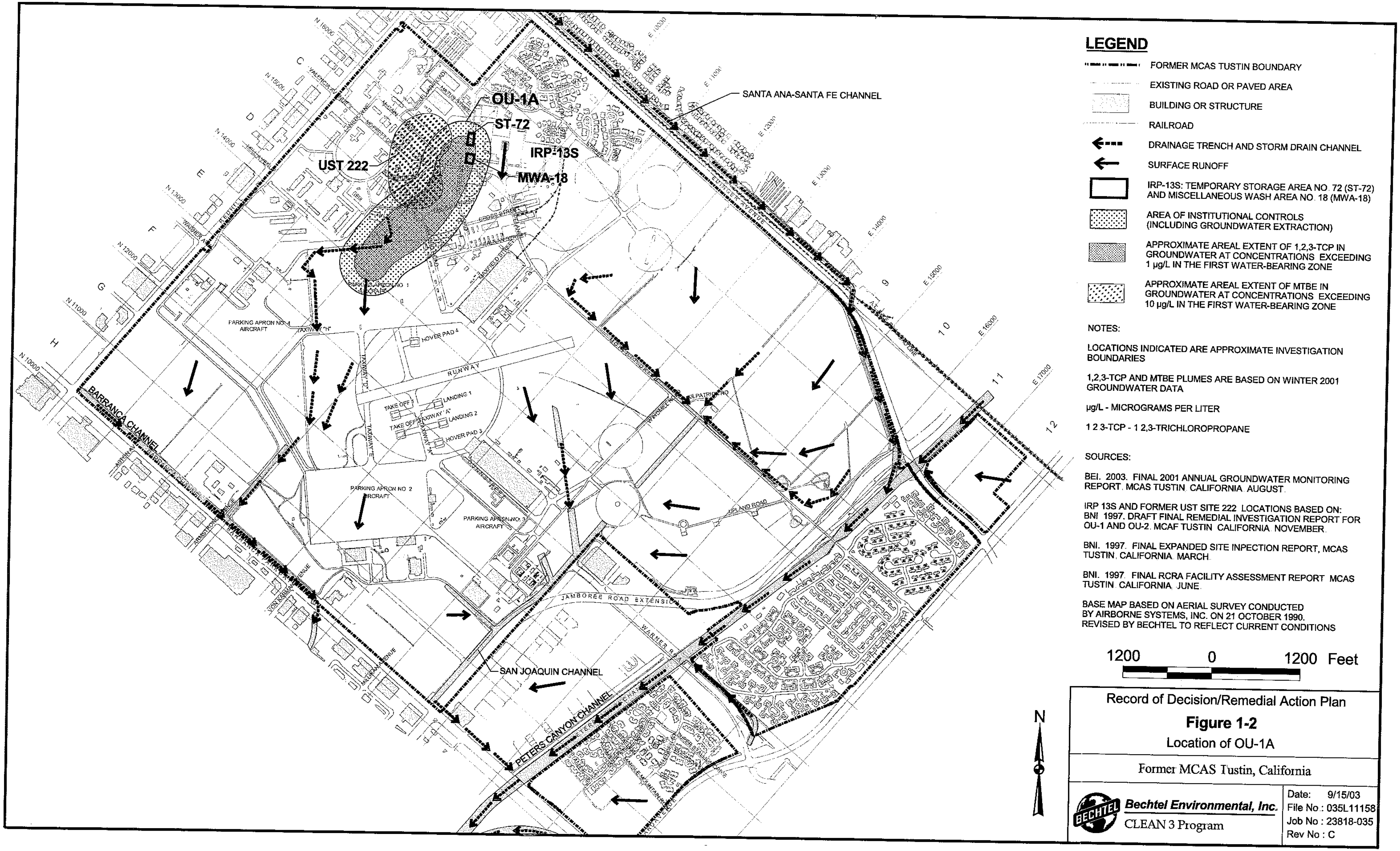
Figure 1-1

Former MCAS Tustin Location Map

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 5/21/02
File No.: 035R8857
Job No.: 23818-035
Rev No.: A



Record of Decision/Remedial Action Plan

Figure 1-2

Location of OU-1A

Former MCAS Tustin, California

Since 1993, the Base Realignment and Closure (BRAC) Cleanup Team (BCT) has coordinated cleanup and closure activities at Former MCAS Tustin. The BCT consists of representatives from the DON, the United States Environmental Protection Agency (U.S. EPA), the Regional Water Quality Control Board (RWQCB) Santa Ana Region, and the DTSC. The DON is the lead federal agency for environmental restoration at Former MCAS Tustin, and the DTSC is the lead regulatory agency providing oversight.

1.4 SITE DESCRIPTION

During previous active operations, the mission of MCAS Tustin was to maintain and operate facilities and to provide services and materials to support operations of a Marine wing, or units thereof, and other activities and units designated by the commandant of the United States Marine Corps (USMC) in conjunction with the Chief of Naval Operations.

To support this mission, operations at the station were expanded over the years to include more than 200 structures and various facilities, including a 3,000-foot-long runway, aircraft parking aprons, and numerous aircraft maintenance shops. Prior to its closure, Former MCAS Tustin occupied approximately 1,595 acres of land, of which approximately 212 acres was used for station housing and 1,383 acres was used for nonhousing purposes. All of the property at the station is developed, except for approximately 674 acres that was previously used for commercial farming. The land around Former MCAS Tustin has residential, commercial/business, industrial, and recreational uses.

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Section 2
SITE HISTORY AND INVESTIGATION ACTIVITIES

This section provides an overview of the history of Former MCAS Tustin and summarizes the investigation activities that have taken place at the station.

2.1 SITE HISTORY

MCAS Tustin was initially established during World War II as a Navy lighter-than-air (LTA) facility to support air patrols off the southern California coast. The station was commissioned in the fall of 1942, upon completion of the construction of two blimp hangars (currently national historic landmarks), and served as an LTA facility until 1949, when it was decommissioned. The station was then used as an outlying field for other military operations in the area, primarily those of MCAS El Toro.

In 1951, MCAS Tustin was reactivated to support the Korean Conflict and was used solely for helicopter operations. The station was officially designated the "Santa Ana Marine Corps Air Facility (MCAF)." As the station expanded its operations, the name was changed on 01 September 1969 to "MCAS (Helicopter[H]) Santa Ana." In 1978, the station name was changed to "MCAS (H) Tustin" to reflect its annexation by the city of Tustin. In 1986, the station was renamed "MCAS Tustin," and in October 1997, the station name was changed to "MCAF Tustin." In 2000, the "MCAF Tustin" designation was dropped, and use of "MCAS Tustin" was officially resumed.

Former MCAS Tustin was initially included on the BRAC II list in 1991; further realignment and complete closure were ordered for the station under the BRAC III list (1993). To facilitate the closure and environmental restoration processes, the DON organized a BCT in 1993. The BCT is composed of representatives of the DON, U.S. EPA, and DTSC, with support from the RWQCB. The BCT has been collectively managing and coordinating cleanup and closure activities at Former MCAS Tustin since its inception.

MCAS Tustin was closed on 02 July 1999. An FFSRA between the DON and DTSC was signed in August 1999. This legal agreement defines the DON's corrective action and response action obligations under CERCLA and RCRA for 16 IRP sites and 288 areas of concern (AOCs) that have been identified at Former MCAS Tustin. A site management plan is used to establish schedules and deadlines for remaining environmental restoration activities and reports (BNI 2001a).

On 14 May 2002, the DON transferred all Former MCAS Tustin property under various conveyance documents to various public agencies. The city of Tustin, recognized as the Local Redevelopment Authority (LRA), received the majority of station property. Carve-out areas delineated within the transferred property have been or will be leased by means of separate lease documents so that remediation can continue while these areas are being redeveloped. Carve-Out Area 5 surrounds the groundwater plumes at IRP-13S (OU-1A) (see Section 6, Figure 6-1). The aforementioned lease documents are used to protect the integrity of groundwater extraction wells and remediation equipment, prevent inadvertent use of or exposure to contaminated groundwater, and allow the DON, DON contractors, and regulatory personnel access to install, operate, and maintain equipment and to monitor the remedial action.

2.2 INVESTIGATION ACTIVITIES

There are no enforcement activities related to OU-1A. Environmental investigation and remediation activities associated with OU-1A are implemented under a stationwide environmental program. The purpose of this program is to identify, investigate, assess, characterize, and clean up or control releases of hazardous substances, as well as to cost-effectively reduce the risk to human health and the environment from past waste disposal operations and hazardous material spills at Navy/Marine Corps stations. The program is administered in accordance with:

- CERCLA, as amended by SARA, and the Community Environmental Response Facilitation Act;
- RCRA;
- National Environmental Policy Act; and
- *California Health and Safety Code*.

The following subsections describe investigations, studies, and removal actions conducted at IRP-13S. Table 2-1 summarizes investigation activities conducted at Former MCAS Tustin.

2.2.1 Soil and Groundwater Investigations

During 1983 and 1984, the DON performed an initial assessment study (IAS) to locate potentially contaminated sites at MCAS Tustin (Brown and Caldwell 1985). The IAS report identified 14 potentially contaminated sites (IRP-1 through IRP-14) based on record searches and employee interviews. The report recommended sampling locations and analytical parameters to confirm the suspected contamination at the sites

IRP-15 was identified in the Site Inspection Plan of Action (JMM 1988a), which recommended nine IRP sites (including IRP-15) for study and amended the site sampling plans proposed in the IAS Report. IRP-16 was identified in the Fuel Farm Area Remedial Investigation (JMM 1988b).

The potential for subsurface contamination at ST-72, included as part of IRP-13S, was first identified under the Navy Assessment and Control of Installation Pollutants program (Brown and Caldwell 1985) and was named as an area to be investigated under a RCRA facility assessment (RFA) (BNI 1997a). Three phases of the RFA included a preliminary review (PR), visual site inspection (VSI), and sampling visit (BNI 1997a). The PR and VSI conducted at ST-72 indicated that hazardous substances may have been stored, handled, disposed of, or released at this site (JEG 1992, BNI 1997a,b). Two RFA sampling visits were conducted at ST-72 in 1995 and 1996 that involved collection of limited field data to address uncertainties remaining from the PR and VSI regarding the

Table 2-1
Summary of Environmental Activities at Former MCAS Tustin

Date	Investigation/ Activity	Objective	Summary of Findings
1983–1984	Initial assessment study	Identify and assess sites posing a potential threat to human health or the environment due to contamination from past hazardous materials operations.	Identified all sites studied as potentially contaminated and recommended IRP-1 through IRP-14 for a confirmation study (Brown and Caldwell 1985).
1987–1988	Former Fuel Farm investigation	Identify COPCs present in groundwater at IRP-16.	Three monitoring wells were installed and sampled. Several VOCs, including TCA, DCA, and toluene, were reported in groundwater (JMM 1988b).
1990–1993	Site inspection	Evaluate nine of the sites (IRP-2, IRP-3, IRP-5, IRP-7, IRP-8, IRP-9, IRP-12, IRP-13, and IRP-15) identified during the initial assessment study.	Further evaluation of IRP-2 and IRP-8 was recommended. An RI/FS was recommended for IRP-3, IRP-5, IRP-7, IRP-9, IRP-12, and IRP-13. No further action was recommended at IRP-15. Removal actions were not recommended for any sites (JEG 1993).
1992	Former Fuel Farm investigation	Identify COPCs present in soil and groundwater at IRP-16.	No VOCs were reported in groundwater. High concentrations of TRPH were reported in soil (JEG 1992).
1994–1995	Expanded site characterization	Determine background levels of COPCs in groundwater and establish baseline geochemistry of MCAS Tustin.	Installed more than 20 wells and drilled more than 30 HydroPunch® borings to establish baseline geochemistry (ANL 1994, 1995).
1994–1995	Expanded site inspection	Evaluate nine IRP/AOC sites (IRP-2, IRP-6, IRP-8, IRP-9, IRP-11, IRP-15, MMS-03, MMS-04, and MMS-05), including soil and groundwater sampling, fate and transport analysis, baseline risk assessment, and screening risk assessment associated with future impacts on groundwater (due to leaching of COPCs in soil).	No further action was recommended for soil at IRP-8, IRP-11, IRP-15, MMS-03, MMS-04, and MMS-05. NTCRA was recommended for soil at IRP-2 and IRP-9. Further evaluation was recommended for soil at IRP-6. No further action was recommended for groundwater at IRP-9, IRP-15, and MMS-03. IRP-2, IRP-6, IRP-8, IRP-11, and MMS-04 and MMS-05 were recommended for further evaluation in the RI stationwide groundwater program, based on the risk assessment and evaluation of COPCs in groundwater (BNI 1997c).
1997	Final RCRA Facility Assessment Report	Fifty of the 258 AOCs were investigated.	Twenty-seven AOCs were recommended for further action, including ST-72 and MWA-18 (BNI 1997a)

(table continues)

Table 2-1 (continued)

Date	Investigation/ Activity	Objective	Summary of Findings
1995–1997	OU-1/OU-2 RI	Evaluate seven sites (IRP-3, IRP-5, IRP-12, IRP-13E, IRP-13W, IRP-13S, and IRP-16). Also perform stationwide groundwater study to evaluate impact of sources of contamination at 29 areas of potential concern identified under the RI, ESI, and RFA programs.	No further action was recommended for 23 of the 29 areas of potential concern (IRP-2, IRP-5, IRP-6, IRP-8, IRP-11, IRP-13E, IRP-13W, and IRP-16 and AOCs AD-04, AS-06, AS-08, AST-02, AST-04, DSS-01, DSS-02, MDA-02, MDA-04, MDA-07, MMS-01, MWA-03, MMS-04, MMS-05, and ST-67). An FS was recommended for IRP-3 (which includes TOW-X3 and TOW-X4), IRP-12, and IRP-13S (ST-72 and MWA-18) (BNI 1997b).
1996	OU-3 RI/FS	Assess nature and extent of contamination at IRP-1 and evaluate remedial action.	Further action was recommended for IRP-1. Recommended remedial action was containment of waste left in place using an existing cover and containment wall for contaminated groundwater (BNI 1996a,b).
1996	Removal action at IRP-16	Excavate and treat petroleum-contaminated soil under a petroleum corrective action.	Approximately 15,000 tons of soil was excavated, of which 6,000 tons of contaminated soil was treated and used for backfill to restore the site. Activities were completed in August 1996 (OHM 1997).
1997	Removal action at IRP-2	Excavate and treat PAH-contaminated soil.	Approximately 569 tons of PAH-contaminated soil was excavated and treated. Activities were completed in June 1997 (BNI 1996c, OHM 1998).
1997–1999	Removal action at IRP-9A and IRP-9B	Excavate and treat PAH-contaminated soil	Approximately 701 tons and 6,837 tons of soil were excavated and treated from IRP-9A and IRP-9B, respectively, for a total of 7,538 tons Activities were completed at IRP-9A in September 1997 and IRP-9B in December 1998 (BNI 1996c, OHM 2000a,b).
1997	Removal action at IRP-13W	Excavate and treat TPH- and PAH-contaminated soil	Approximately 4,000 tons of soil was removed, and site restoration activities (paving and fencing) were performed as part of an NTCRA at IRP-13W. Activities were completed in November 1997. Following this RA, IRP-13W was recommended for NFA in the OU-1/OU-2 RI (BNI 1997b).

(table continues)

Table 2-1 (continued)

Date	Investigation/ Activity	Objective	Summary of Findings
1997	Post-RI field program at IRP-12	Verify the distribution of TCE in soil at IRP-12.	Confirmed the data interpretations presented in the RI Report: additional TCE source areas were not identified at IRP-12, and the boundary of TCE-contaminated soil at IRP-12 was not modified (BNI 1998a).
1998	VEE pilot-scale tests for OU-1	Evaluate the effectiveness of a VEE system for groundwater extraction and treatment at OU-1.	VEE was demonstrated to produce a slight increase in the effectiveness of TCE mass removal and to achieve a slightly wider radius of influence in comparison with conventional extraction technology. Based on this finding, it was recommended that VEE be considered as an alternative in the OU-1 FS (BNI 1999a).
1999	OU-1 FS	Evaluate remedial alternatives for IRP-3, IRP-12, and IRP-13S.	Six remedial alternatives were evaluated: no action, natural attenuation, hydraulic containment, groundwater extraction, permeable iron wall, and vacuum-enhanced groundwater extraction (BNI 1999b).
1999	BCT meeting 23 September 1999	Modify recommended action for six IRP sites and six AOCs.	Recommended a focused FS for IRP-5, IRP-6, IRP-8, IRP-11, IRP-13W, and IRP-16 and AOCs DSS-01, DSS-02, MDA-02, MMS-04, MMS-05, and ST-67 due to the presence of contaminants in shallow groundwater at concentrations exceeding regulatory limits. These sites/AOCs are now included in OU-4.
1999	Removal of TOW-X3 and TOW-X4	Remove O/W separators and TPH/TCE-contaminated soil.	Based on confirmation soil sampling results, TOW-X3 and TOW-X4 are considered potential sources of IRP-3 groundwater contamination. It was recommended that closure for these AOCs be conducted under the CERCLA program (IT 2000, OHM 2001a)
1999–2001	Stationwide groundwater monitoring at IRP-1, IRP-3, IRP-6, IRP-12, and IRP-13S, mingled plumes area, and UST Site 222	Evaluate groundwater contamination and plume movement through RIs and FSs, remedial design, and remedial action phases for various OUs at MCAS Tustin	Groundwater monitoring results supported interpretations of stationwide groundwater flow patterns, groundwater chemistry, and contaminant distributions developed from monitoring conducted during the RI and subsequent interim monitoring (BNI 2000a, 2001b, BEI 2003a).

(table continues)

Table 2-1 (continued)

Date	Investigation/ Activity	Objective	Summary of Findings
2000	ROD/RAP for OU-2	Select remedy for OU-2 sites and AOCs.	The selected remedy for the three IRP sites and nine AOCs that comprise OU-2 was no action.
2001	ROD/RAP for OU-3	Select remedy for IRP-1.	Selected remedial action consists of institutional controls; groundwater, surface water, and landfill gas monitoring; and inspection and maintenance of the existing containment wall and cover, French drain systems, monitoring wells, and security features.
2001–2002	TCRA at IRP-13S	Coordinate with petroleum corrective action being conducted for MTBE plume migration at adjacent UST Site 222. OU-1 was divided into OU-1A and OU-1B to facilitate remedial action at IRP Sites 3 and 12.	In December 2001, installation of a groundwater extraction and treatment system including seven extraction wells and ten monitoring wells was completed at IRP-13S. The purpose of the treatment system was to hydraulically contain VOC contamination within the current plume boundary at IRP-13S and prevent or minimize crossgradient migration of contaminants from IRP-13S that might occur as a result of a petroleum corrective action being conducted at adjacent UST Site 222. Interim removal at IRP-13S began in January 2002, and performance monitoring used to evaluate the effectiveness of the removal action, is ongoing as of March 2004.
2001–2002	OU-1B FS	Evaluate remedial alternatives for IRP-3 and IRP-12.	Nine remedial alternatives were evaluated: no action, monitored natural attenuation, hydraulic containment, aggressive groundwater extraction with off-site soil disposal, aggressive groundwater extraction with on-site soil treatment, permeable iron wall, VEE with off-site disposal, VEE with on-site soil treatment, and hydraulic containment with hot spot removal (BNI 2002)
2003	OU-1B RAP/ROD	Record of Decision and Selected Remedial Action Plan for OU-1B (IRP-3 and IRP-12)	The preferred remedy is documented in the OU-1B ROD: hydraulic containment with hot spot removal (Alternative 7) (SWDIV 2003a).

(table continues)

Table 2-1 (continued)

Date	Investigation/ Activity	Objective	Summary of Findings
2003	OU-1A FS	Evaluate remedial alternatives for OU-1A (IRP-13S).	Nine remedial alternatives were evaluated: no action, monitored natural attenuation, hydraulic containment, aggressive groundwater extraction with off-site soil disposal, aggressive groundwater extraction with on-site soil treatment, permeable reaction wall, VEE with off-site disposal, VEE with on-site soil treatment, and hydraulic containment with hot spot removal (BEI 2003b).
2003–2004	OU-4 Technical Memorandum	Shallow groundwater investigation of selected sites	Recommended IRP-5N, IRP-5S(b), IRP-8, IRP-11 (Area A), IRP-16, and MMS-04 (Areas A and C) for NFA; these sites became OU-4A. Recommended IRP-5S(a), IRP-6, IRP-11 (Area B), IRP-13W, MMS-04 (Area B), and Mingled Plumes Area for further action; these sites became OU-4B.
2004	OU-4A NFA ROD/RAP	Select NFA for OU-4A sites	Issued draft NFA ROD/RAP to present the selected remedy of no action for the OU-4A sites.
2004	OU-4B FFS	Evaluate remedial alternatives for OU-4B.	In preparation.

Acronyms/Abbreviations:
- AOC – area of concern
- BCT – Base Realignment and Closure Cleanup Team
- CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
- COPC – chemical of potential concern
- DCA – dichloroethane
- ESI – expanded site inspection
- FFS – focused feasibility study
- FS – feasibility study
- IRP – Installation Restoration Program
- MCAS – Marine Corps Air Station
- MMS – miscellaneous major spill
- MTBE – methyl tert-butyl ether
- NFA – no further action
- NTCRA – non-time-critical removal action
- OU – operable unit
- O/W – oil/water
- PAH – polynuclear aromatic hydrocarbon
- RA – removal action
- RAP – remedial action plan
- RCRA – Resource Conservation and Recovery Act
- RFA – RCRA facility assessment
- RI – remedial investigation

(table continues)

Table 2-1 (continued)

Acronyms/Abbreviations: (continued)
ROD – record of decision
TCA – trichloroethane
TCE – trichloroethene
TCRA – time-critical removal action
TPH – total petroleum hydrocarbons
TRPH – total recoverable petroleum hydrocarbons
UST– underground storage tank
VEE – vacuum-enhanced extraction
VOC – volatile organic compound

extent of soil and groundwater contamination. A screening-level risk assessment and a preliminary analysis of contaminant fate and transport were also performed (BNI 1997a). The screening-level risk assessment for ST-72 indicated the chemicals of potential concern (COPCs) in groundwater presented unacceptable carcinogenic risk and adverse systemic effects (BNI 1997a).

The RFA sampling visit activities identified an extensive 1,2,3-trichloropropane (TCP) groundwater plume originating from ST-72 (BNI 1997a). On the basis of the RFA sampling visits, the DON determined that volatile organic compound (VOC) contamination in the groundwater plume originating at ST-72 extended beyond the site's boundaries and would therefore be more appropriately managed under the CERCLA program.

An OU-1/OU-2 remedial investigation (RI) was conducted from 1995 through 1997 to evaluate seven sites, including IRP-13S (BNI 1997b). It consisted of a field investigation followed by an evaluation of the nature and extent of contamination, a fate and transport analysis, and a baseline human-health risk assessment (HHRA). In addition, the RI included a stationwide groundwater study to evaluate the impact of COPCs present in soil and groundwater. The RI identified a trichloroethene (TCE) plume originating from MWA-18 located within the 1,2,3-TCP plume (originating from ST-72). ST-72 and MWA-18, therefore, were identified for CERCLA closure in association with IRP-13S (BNI 1997b).

In 1998, a limited deep HydroPunch® investigation was conducted to evaluate potential mechanisms for migration of 1,2,3-TCP into the third water-bearing zone (WBZ) at IRP-13S (BNI 1999c). Investigation results indicated that a localized lithologic discontinuity (an area with relatively coarser-grained materials) in the vicinity of well IS72MW2D2, plus seasonal reversals of the vertical hydraulic gradients evident over several years of monitoring provided the mechanisms for limited migration of VOCs from the second to the third WBZ at that location. The investigation also confirmed that groundwater flow in the third WBZ was to the west compared to a south-southwesterly direction in the second and first WBZs.

OHM Remediation Services Corp. excavated the soil at MWA-18 and ST-72 based on data from previous RFA sampling events (OHM 2001b,c). ST-72 was identified as the probable source of 1,2,3-TCP in groundwater based on limited soil sampling performed adjacent to Building 16 during the RI. ST-72 was subsequently split into ST-72A (Building 16) and ST-72B (Building 50). ST-72A (Building 16) consisted of a 40- by 47-foot concrete pad with a hydraulic lift. The DON recommended ST-72A for no further action based on further soil sampling results that indicated no reportable concentrations of 1,2,3-TCP in soil at the site (OHM 2001d).

Ongoing interim groundwater monitoring has been conducted at Former MCAS Tustin since 1997 to evaluate the basewide hydrogeologic setting and changes in contaminant distribution at each of the sites originally investigated during the RI (BNI 1997b). Interim groundwater monitoring is planned to continue throughout the remedial action period.

In January 2002, a time-critical removal action (TCRA) for 1,2,3-TCP in groundwater was undertaken at IRP-13S. The purpose of the TCRA was to initiate hydraulic containment of groundwater contaminated with 1,2,3-TCP within present plume boundaries in the first and second WBZs to prevent further vertical and/or horizontal migration until the final remedy is implemented or plume migration is stabilized (SWDIV 2003a). Results from quarterly groundwater monitoring conducted during summer 2002 indicate the TCRA system is effectively containing the VOC plumes (PTES 2002). Components of the TCRA system (e.g., extraction wells) are not included in the evaluation of the remedial action alternatives for OU-1A. However, if components of the TCRA system were incorporated into the final remedy, they would likely enhance the effectiveness of the remedy (SWDIV 2003a). The TCRA groundwater treatment system is being closely coordinated with remedial activities at underground storage tank (UST) Site 222, managed by the DON under the Petroleum Corrective Action Program (PCAP).

2.2.2 Feasibility Studies

A draft OU-1 Feasibility Study (FS) Report was issued in 1999 (BNI 1999b). This report identified and screened six remedial alternatives for IRP-3, IRP-12, and IRP-13S. In 2001, while the FS Report was being finalized, a petroleum corrective action was proposed for a methyl tert-butyl ether (MTBE) plume associated with UST Site 222. Because groundwater extraction proposed as part of the MTBE removal action had the potential to cause westward or crossgradient migration of the IRP-13S groundwater plume, OU-1 was separated into OU-1A (IRP-13S) and OU-1B (IRP-3 and IRP-12). This allowed the DON to coordinate the petroleum corrective action at UST Site 222 with the TCRA at IRP-13S while proceeding to develop a separate remedy for OU-1B (IRP-3 and IRP-12). UST Site 222 has been identified as the source area for the MTBE plume. Cleanup of the MTBE plume is being managed under the PCAP, a separate compliance program, and the contamination at OU-1A is being addressed under CERCLA.

In August 2003, the final FS Report was issued for OU-1A that identified and screened nine potential remedial alternatives developed for IRP-13S (BEI 2003b).

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Section 3
HIGHLIGHTS OF COMMUNITY PARTICIPATION

A community relations plan was developed to document concerns identified during community interviews and to provide a detailed description of community relations activities planned in response to information received from the community. Initially prepared in 1991, the plan was revised in 1993, revised again in 1995, and updated in 2002 to incorporate the most recent assessment of community issues, concerns, and informational needs about the ongoing environmental investigation and remediation program at Former MCAS Tustin (BEI 2002).

The community relations program includes specific activities for obtaining community input and keeping the community informed. These activities include conducting interviews, holding public meetings, issuing fact sheets to provide updates on current investigations and remediation activities, maintaining an information repository where the public can access technical documents and program information, disseminating information to local and regional media, and making presentations to local groups.

Community members and local government agencies have also participated in planning for the reuse of Former MCAS Tustin through development of the MCAS Tustin Specific Plan (SP), as adopted by the Tustin City Council on 03 February 2003.

3.1 RESTORATION ADVISORY BOARD

In 1994, establishment of the Restoration Advisory Board (RAB) gave individuals from local communities a channel for increasingly significant participation in the environmental restoration process. Original membership on the board, which was solicited by the USMC and the DON through paid newspaper notices, included business and homeowners' association representatives, locally elected officials and local regulatory agencies, and interested residents.

Currently, the RAB is composed of 20 registered members: 11 community members or private citizens and 9 representatives from various government agencies. RAB meetings are held every 2 months and are scheduled in the evenings after normal working hours (7:00 to 9:00 p.m.) at either of two locations, depending upon availability: the Clifton Miller Center at the city of Tustin City Hall or the Tustin Senior Center at 200 South C Street in downtown Tustin. The meetings are open to the public and include representatives from the USMC and the DON, city and county offices, and regulatory agencies. By sharing information from the regular meetings with the groups they represent, RAB members help increase awareness and progress of the IRP process; in addition, members of the public can contact RAB members to obtain information or express concerns to be discussed at subsequent meetings.

Copies of the RAB meeting minutes are available at the Former MCAS Tustin information repository, located at the University of California, Irvine (UCI) Main Library, Government Publication Department. RAB meeting minutes are also located on the DON's Southwest Division Naval Facilities Engineering Command environmental website: http://www.efdsw.navfac.navy.mil/environmental/Tustin.htm.

VOC-contaminated soil and groundwater at OU-1A have been a key topic for presentations and discussions at several RAB meetings. Early presentations focused on the RI and provided background and educational information to RAB members on the extent of groundwater contamination. Subsequent meetings concentrated on the remedial alternatives under consideration for this site.

3.2 PUBLIC MAILINGS

Public mailings, including information updates, fact sheets, and proposed plans/draft RAPs, have been used to broaden the dissemination of information within the local community. The first information update announcing the IRP process at Former MCAS Tustin was delivered in February 1993 to MCAS Tustin area residents and mailed to city, state, and federal officials; agencies; local groups; and individuals identified in the Community Relations Plan. Subsequent fact sheets were mailed to the community as significant remediation milestones were reached (Table 3-1). These publications included information concerning the status of site investigations, the upcoming remedy selection process, ways for the public to participate in the investigation and remediation of Former MCAS Tustin, and the availability of the MCAS Tustin administrative record.

Proposed plans or proposed plans/draft RAPs are summaries of remedial alternatives proposed for a site or group of sites. These plans describe each alternative, evaluate each alternative against nine criteria, and identify the preferred alternative. Proposed plans/draft RAPs are issued to the public before the beginning of a public comment period to provide information and solicit public input on the remedial options that underwent detailed evaluation in feasibility studies. Once the public comment period closes, the comments are compiled, reviewed by the BCT, and used to refine the remedial action. The final decision and responses to comments (known as a "Responsiveness Summary") are presented in this ROD/RAP.

To reach as many community members as possible, the updates, fact sheets, and proposed plans/draft RAPs are mailed to approximately 400 households, businesses, public officials, and agencies. Copies are also made available at the information repository at the UCI Library and in the administrative record at Former MCAS El Toro (which contains the MCAS Tustin administrative record file).

3.3 COMMUNITY PARTICIPATION FOR OU-1A

During 2001, OU-1 was divided into OU-1A (IRP-13S) and OU-1B (IRP-3 and IRP-12). The FS Report for OU-1A was issued in August 2003. The Proposed Plan/draft RAP for OU-1A, which describes the DON's preferred alternative, was communicated to the public in August 2003.

The RI Report for OU-1, the FS Report for OU-1A, the Proposed Plan/draft RAP for OU-1A, and other key documents related to IRP-13S were made available to the public at the information repository at the UCI Library. Notices of availability of these site-related documents were published in the *Orange County Register* and the *Los Angeles Times*

Table 3-1
Summary of Former MCAS Tustin Updates, Fact Sheets, and Proposed Plans

Fact Sheet Number	Date	Summary of Contents
—*	02/93	The Environmental Cleanup of MCAS Tustin
—	06/94	New Environmental Committee to Hold Workshop
1	02/95	Soil Treatment Process Selected for Cleanup of Former Fuel Farm Area
2	12/95	It's Official: Excavation and Treatment of Contaminated Soil Is Under Way
3	01/96	Fast-Track Studies Focus on Reducing Cost and Schedule at MCAS Tustin
—	10/96	Proposed Plan for Landfill Trenches and Crash Crew Burn Pits
4	04/97	Cleanup Activities Complete at Former Fuel Tank Farm
5	10/97	Groundwater Contamination and Cleanup – An Overview
6	01/98	Identifying and Selecting Technologies and Alternatives for Groundwater Treatment
—	01/00	Proposed Plan/Draft Remedial Action Plan for No Further Action at Three IRP Sites and Nine AOCs
7	10/01	The Environmental Cleanup of MCAS Tustin, Status Update
—	04/02	Proposed Plan/Draft Remedial Action Plan for OU-1B
—	08/03	Proposed Plan/Draft Remedial Action Plan for OU-1A
—	02/04	Fact Sheet for Change in Soil Disposal Component of Selected Remedies at OU-1A and OU-1B

Note:
* dash indicates updates or proposed plans that are not given fact sheet numbers

Acronyms/Abbreviations:
AOC – area of concern
IRP – Installation Restoration Program
MCAS – Marine Corps Air Station
OU – operable unit

(Orange County Edition) on 07 August 2003. The notices also announced the availability of the complete administrative record file at the SWDIV BRAC office in San Diego and at Former MCAS El Toro. Because of space limitations at the library, only a partial administrative record file is available for review at the information repository, but the information repository contains a complete index of the administrative record file along with information about how to access the complete file at Former MCAS El Toro.

The public comment period for the Proposed Plan/draft RAP for OU-1A was held from 08 August to 08 September 2003, and a public meeting was held on 21 August 2003. The public meeting was announced in the *Orange County Register* and the *Los Angeles Times (Orange County Edition)* on 14 August 2003 and in the Proposed Plan/draft RAP. At the public meeting, representatives from the DON, Former MCAS Tustin, and environmental regulatory agencies answered questions about site conditions and the preferred remedial alternative under consideration. A court reporter recorded public comments. Comment forms were provided to encourage submittal of written comments during or after the meeting. Responses to the comments received during this period are included in the Responsiveness Summary, which is part of this ROD/RAP.

Section 4
SCOPE AND ROLE OF OPERABLE UNIT

There are currently six OUs at MCAS Tustin: OU-1A, OU-1B, OU-2, OU-3, OU-4A, and OU-4B. Each OU has been or will be addressed in a separate ROD/RAP. OU-1A focuses on groundwater contamination at IRP-13S, and OU-1B focuses on groundwater contamination at IRP-3 and IRP-12. OU-1A is addressed in this ROD/RAP.

OU-1 originally addressed groundwater contamination at IRP-3, IRP-12, and IRP-13S. In 2001, OU-1 was divided into OU-1A and OU-1B to accommodate implementation of a TCRA at IRP-13S under OU-1A while work progressed separately on the remedial action for IRP-3 and IRP-12 under OU-1B. Interim groundwater removal under the TCRA, which does not represent the final remedy for groundwater contamination at OU-1A, began in January 2002. The Proposed Plan/draft RAP and the draft final ROD/RAP for OU-1B have been submitted to the DON and regulatory agencies. The ROD/RAP for OU-1B is anticipated to be signed and become final in the spring of 2004.

OU-2 comprises IRP-2, IRP-9 (A/B), and IRP-13E; and AOCs AD-04, AS-06, AS-08, AST-02, AST-04, MDA-04, MDA-07, MMS-01, and MWA-03. These OU-2 sites and AOCs were addressed in a No Action ROD/RAP that was finalized in September 2000.

OU-3 comprises all contaminated media at the former Moffett Trenches and Crash Crew Burn Pits Site (IRP-1). The ROD/RAP for OU-3 was finalized in December 2001. A final Operation and Maintenance Plan (OMP) for this site was issued in May 2003 (BEI 2003c). In March 2004, the BCT approved the site to be "Operating Properly and Successfully."

OU-4 was created in 1999 from OU-2 sites that required further evaluation due to relatively low concentrations of VOCs reported in groundwater. OU-4 was initially divided into OU-4A and OU-4B in 2003. Sites recommended for no further action (NFA) were placed in OU-4A, which consists of IRP-5 North, IRP-5 South(b), IRP-8, IRP-11 (Area A), IRP-16, and AOC MMS-04 (Areas A and C). A draft NFA ROD/RAP for OU-4A was issued in August 2004.

Sites recommended for further action were place in OU-4B, which consists of IRP-5 South(a), IRP-6, IRP-11 (Area B), IRP-13W, MMS-04 (Area B), and the Mingled Plumes Area. Potential remedial alternatives for OU-4B sites are being evaluated in a focused feasibility study.

In addition to the sites included within the five OUs, there are three IRP sites that are not included in a designated OU.

- IRP-4 was designated for an RFA site visit (SV). Based on the results of the SV, this site was redesignated by the BCT as AOC MMS-03. AOC MMS-03 received a no further action determination by the BCT on 24 July 1997 (MCAS Tustin BCT 1997).
- IRP-7 was investigated in the OU-1/OU-2 RI. Based on the results of this investigation, the site was redesignated by the BCT as AOC MFL-1 and was transferred out of the CERCLA process because of a petroleum exclusion. Contamination at MFL-1 was addressed under the RWQCB PCAP, and AOC MFL-1 received a no further action concurrence from RWQCB on 21 December 1999.
- IRP-15 was purported to have been a disposal site for creosote-treated lumber dating from 1942. Site inspections and document reviews failed to confirm the existence of

this site, and it was eliminated from further study before the expanded site inspection (ESI). During a 20 March 1996 BCT meeting, it was agreed that IRP-15 required no further action, and a closure letter was signed by the members of the BCT. A copy of the closure letter is included in Appendix A of the ESI Report (BNI 1997c).

Section 5
SITE CHARACTERISTICS

This section describes the regional characteristics of Former MCAS Tustin, provides a brief history of the sources of contamination at IRP-13S, and summarizes results of monitoring performed at this site. This section also discusses potential current and future migration of contaminants identified at the site and presents estimates of the mass of TCE and 1,2,3-TCP present in groundwater. The interpretation of the nature and extent of contamination at IRP-13S is based on data from the site investigation (SI), RI, post-RI soil study, FS, TCRA, and interim groundwater monitoring. The RI, SI, and FS Reports contain complete discussions of sampling locations and methodologies, site-related chemicals identified at each site, and the nature and extent of contamination (BNI 1997b,c, 1998a; BEI 2003b).

5.1 REGIONAL CHARACTERISTICS

Former MCAS Tustin lies at the eastern edge of a broad coastal plain (an essentially planar, alluviated flatland) that is bounded on the east-northeast by the gentle slopes of Lomas de Santiago (along the foothills of the Santa Ana Mountains) and on the south by the San Joaquin Hills. The coastal plain slopes gently southwestward toward the Pacific Ocean. The ground surface at the former station is essentially flat, with an average elevation of approximately 54 feet above mean sea level (MSL). The ground surface slopes gradually from approximately 75 feet above MSL at the northern portion of the station to approximately 45 feet above MSL at the southern portion. The geology, hydrogeology, and surface water hydrology of Former MCAS Tustin are briefly described below.

5.1.1 Geology and Hydrogeology

A groundwater-level contour map for the regional aquifer is provided on Figure 5-1. In the vicinity of Former MCAS Tustin, the coastal plain is underlain by approximately 1,300 feet of unconsolidated sediments. Sediments from the ground surface to depths from approximately 90 to 150 feet below ground surface (bgs) consist of massive silt, clayey silt, clay, and silty clay deposits with laterally discontinuous lenses of sand and gravel. Collectively, the permeable water-bearing sediments of these floodplain and fluvial deposits within the upper 90 to 150 feet bgs are referred to as the "shallow aquifer." The top of the "regional aquifer," a transmissive sand zone, is encountered below approximately 150 feet bgs (Figure 5-2).

Three WBZs constitute the shallow aquifer beneath Former MCAS Tustin. These WBZs are identified in part by the depth intervals at which they occur. The first WBZ occurs from approximately 5 to 30 feet bgs, the second from approximately 30 to 60 feet bgs, and the third from approximately 60 feet bgs to between 90 and 120 feet bgs. The boundaries between the WBZs vary from location to location, reflecting the heterogeneity of the sediments within each depth range (Figure 5-2).

Groundwater at Former MCAS Tustin is first encountered at depths from approximately 5 to 15 feet bgs (30 to 60 feet above MSL). Hydraulic testing completed during the RI indicated that groundwater in the uppermost sand zone in the first WBZ is pressurized, indicating semiconfined conditions within the first WBZ. Groundwater within the second and third WBZs is also semiconfined.

Groundwater within the first WBZ contains total dissolved solids (TDS) at elevated concentrations, averaging approximately 6,000 milligrams per liter (mg/L). Field data suggest that the first and second WBZs are hydraulically interconnected. However, TDS concentrations in the second WBZ are typically lower than those in the first WBZ and average approximately 2,400 mg/L. Field data also suggest that the third WBZ is usually separated hydraulically from the second WBZ and appears to be a transitional zone between the shallow aquifer and the underlying regional aquifer.

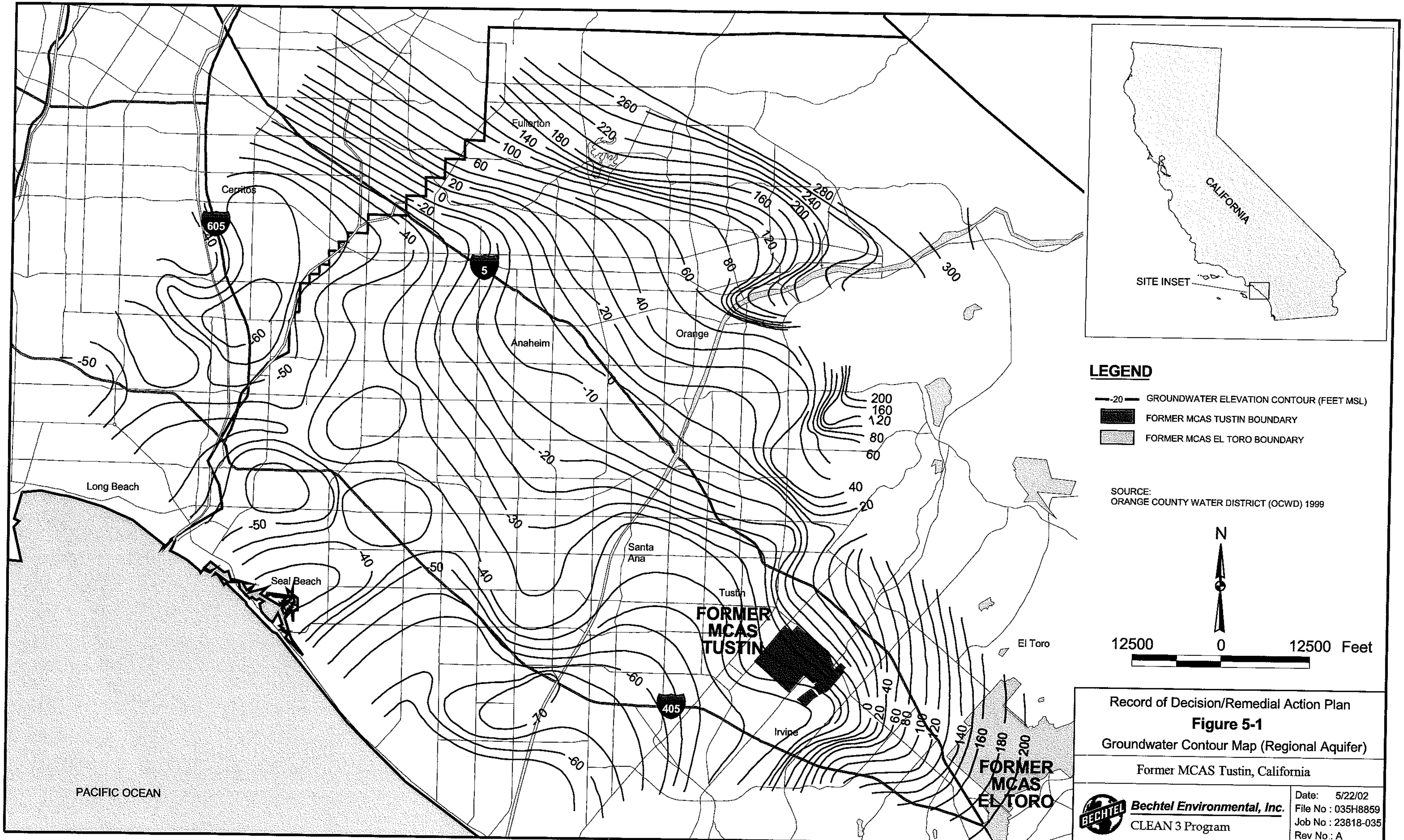
Groundwater flow in the three WBZs has been monitored with well clusters located throughout Former MCAS Tustin. Groundwater in the first and second WBZs generally flows in the same direction, from north to south across the station. In localized areas where the shallow aquifer intercepts the land surface at Peters Canyon Channel, Barranca Channel, and Santa Ana-Santa Fe Channel, groundwater from the first WBZ discharges into these surface water drainages. Groundwater from the third WBZ generally flows toward the southwest and is apparently not influenced by the surface drainages at Former MCAS Tustin.

5.1.2 Surface Water Hydrology

Former MCAS Tustin is located within the Irvine Forebay Pressure groundwater subbasin. Surface waters in this subbasin consist typically of small streams, flood channels, and water-storage reservoirs. Three man-made channels bound Former MCAS Tustin: Barranca Channel to the south, Santa Ana-Santa Fe Channel to the north, and Peters Canyon Channel to the east (Figure 5-3). These unlined channels are incised approximately 10 to 20 feet below the surrounding land surface and permit flow between groundwater and surface water. These channels and the San Joaquin Ditch, which is located in the southern portion of the station, typically contain water year-round.

Data obtained during the RI indicate that both Barranca and Peters Canyon Channels are "gaining" streams in the reach of Former MCAS Tustin, while Santa Ana-Santa Fe Channel loses water in its western reach and gains water in its eastern reach. The San Joaquin Ditch is a main on-site drainage ditch, portions of which have been designated as U.S. Army Corps of Engineers (USACE) jurisdictional wetlands (Figure 5-3). The San Joaquin Ditch collects stormwater in the central and eastern portions of Former MCAS Tustin and discharges the water into Peters Canyon Channel through a conduit beneath Barranca Parkway.

Surface drainage at the station is controlled by local topography and by various man-made drainages. Surface runoff at Former MCAS Tustin originates almost entirely from within the station, because runoff flowing toward the station from the north and northeast is intercepted by ditches running parallel to the Santa Fe Railroad tracks located along the northeast side of the station. Surface runoff as excess precipitation leaves the station in



Record of Decision/Remedial Action Plan

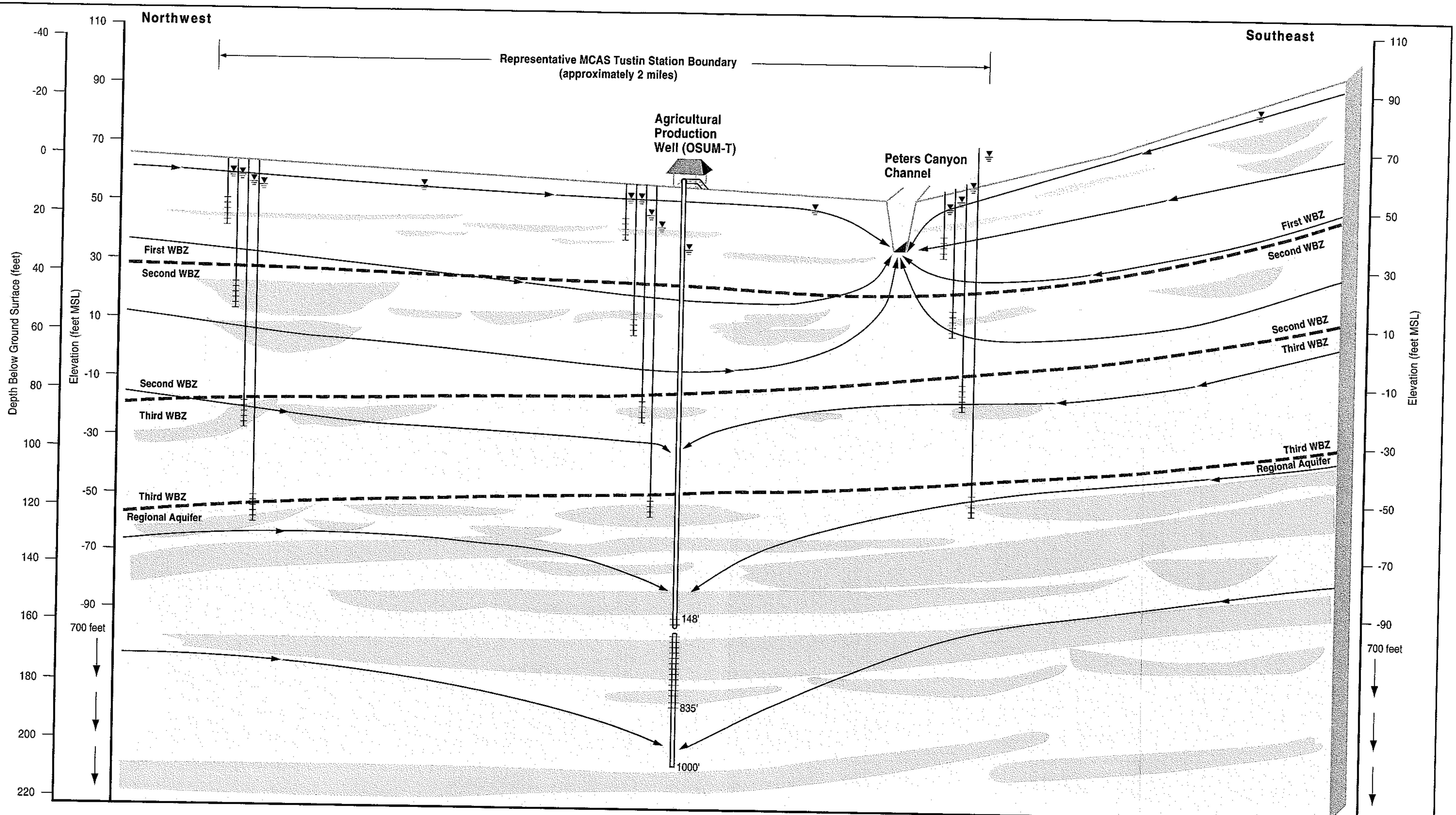
Figure 5-1

Groundwater Contour Map (Regional Aquifer)

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 5/22/02
File No : 035H8859
Job No : 23818-035
Rev No : A



Legend

Clayey Silt and Clay
Silty Sand and Sand
Water Level
Groundwater Flow Direction
Monitoring Well
Production Well

Acronyms/Abbreviations:

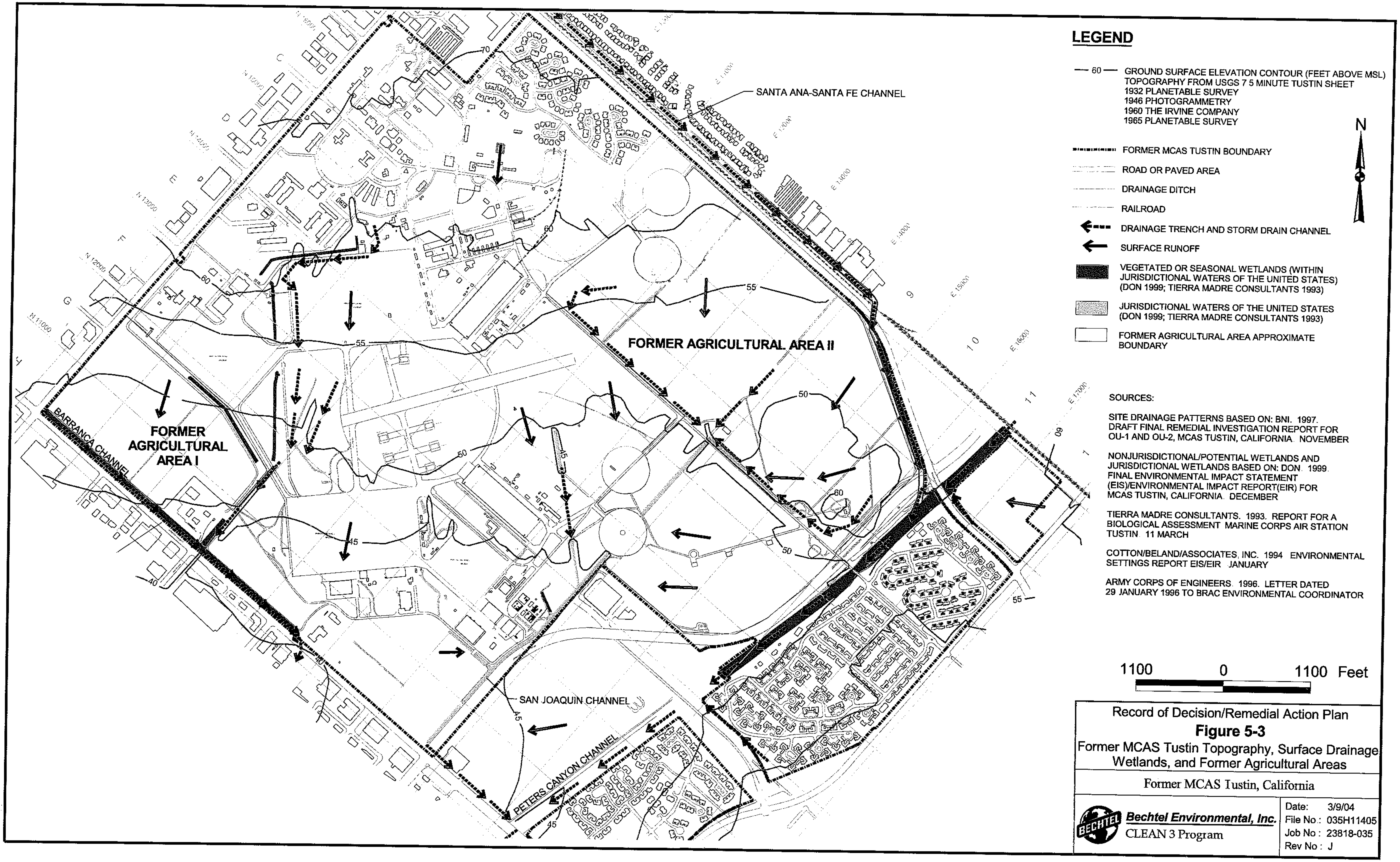
MSL mean sea level
WBZ water-bearing zone

Record of Decision/Remedial Action Plan
Figure 5-2
Former MCAS Tustin
Conceptual Hydrogeologic Model

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 3/9/04
File No 035X11404
Job No 23818-035
Rev No B



Record of Decision/Remedial Action Plan

Figure 5-3

Former MCAS Tustin Topography, Surface Drainage Wetlands, and Former Agricultural Areas

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 3/9/04
File No: 035H11405
Job No: 23818-035
Rev No: J

two ways: through the underground storm drainage system or through open ditches and channels. Peters Canyon Channel and Barranca Channel receive surface runoff and storm drain discharge from Former MCAS Tustin.

Surface water generally flows to the south and southwest, away from Former MCAS Tustin (Figure 5-3). Along two boundaries of the station, however, Santa Ana-Santa Fe Channel and Barranca Channel carry flow to the southeast toward Peters Canyon Channel. Short ditches running along the Santa Fe Railroad tracks and along Warner Avenue and a culvert beneath Edinger Avenue carry flow to the northwest toward Peters Canyon Channel. Peters Canyon Channel receives runoff from Santa Ana-Santa Fe Channel on the northeast side of the station and from San Joaquin Ditch in the center of the station. Peters Canyon Channel merges with San Diego Creek approximately 1 mile southwest of the station. Barranca Channel merges with San Diego Creek approximately 2 miles southwest of the station. San Diego Creek empties into upper Newport Bay approximately 5 miles southwest of the station.

5.2 IRP-13S: ST-72 AND MWA-18

IRP-13S is located in the northwest portion of the Former MCAS Tustin property, adjacent to Severyns Street and north of Berry Road (Figures 1-2 and 5-4). IRP-13S occupies approximately 0.7 acre and is the source of the VOC-contaminated groundwater plume originating from ST-72 and MWA-18 (Figure 1-2). ST-72 and MWA-18 are separated by a distance of approximately 100 feet. ST-72 contains two buildings (part of Building 16 and the former Building 50) used for vehicle maintenance in the former Ground Support Equipment (GSE) Yard. MWA-18 is a former washpad used for cleaning small generators and other field equipment.

5.2.1 Site History

Vehicle maintenance activities were formerly conducted at ST-72, located in the northern portion of IRP-13S (Figure 5-4). ST-72 consists of the southern half of Building 16, the former Building 50, and the paved area surrounding the buildings. This area was part of the former GSE Yard constructed in 1942 (Brown and Caldwell 1985, JEG 1992). The southern half of Building 16 operated as a GSE maintenance garage from 1942 through 1993. From then until recently, it housed administrative functions (BNI 1998a). A hoist lift with a below-grade waste oil collection sump is still present at ST-72. Cleaning solvents were reportedly used at ST-72 as degreasers to wash down floors in the buildings, and waste solvent was likely released to storm drains or to the ground outside the building (Brown and Caldwell 1985). By 1985, biodegradable soaps were being used for this purpose instead of solvents (BNI 1997b).

Building 50, located south of Building 16, was used as a vehicle lubrication facility within the former GSE Yard from the mid-1960s until the mid-1970s. Building 50 was demolished in 1982, and the area was then used as a parking lot before the station's closure (JEG 1992). A steam-cleaning wash rack reportedly existed on the south side of the building (Brown and Caldwell 1985) Currently, the footprint of former Building 50 consists of a concrete pad with the remains of a hydraulic lift in the middle. Jacobs Engineering Group Inc. (JEG) reported that the sumps below the former lift were filled with sediment and appeared to be stained (JEG 1992). However, no visible evidence of the sumps associated with former Building 50 has been found, and no records are available to indicate whether the sumps had been excavated or left in place (BNI 1997a).

MWA-18 is currently an inactive washpad located west of Building 47 within the former GSE Yard that comprises the southern portion of IRP-13S. Installed in the 1940s, MWA-18 was used for washing small generators and other field equipment, and consists of a concrete pad (50 by 56 feet) sloped to a drain. No oil/water separator was connected to MWA-18. JEG reported numerous cracks in the concrete pad and stated that its overall integrity appeared to be poor (JEG 1992). During the RFA, washwater from USMC equipment-cleaning activities several hundred feet north of MWA-18 was observed to drain across an asphalt-covered parking lot toward MWA-18 (BNI 1997a).

5.2.2 Site Investigations

The following subsections serve as a summary of previous investigations related to IRP-13S.

5.2.2.1 INITIAL ASSESSMENT STUDY

ST-72 was first identified as a potential source for subsurface contamination in the IAS Report completed under the Navy Assessment and Control of Installation Pollutants Program (Brown and Caldwell 1985). ST-72 was recommended for further investigation in an RFA Report (BNI 1997a).

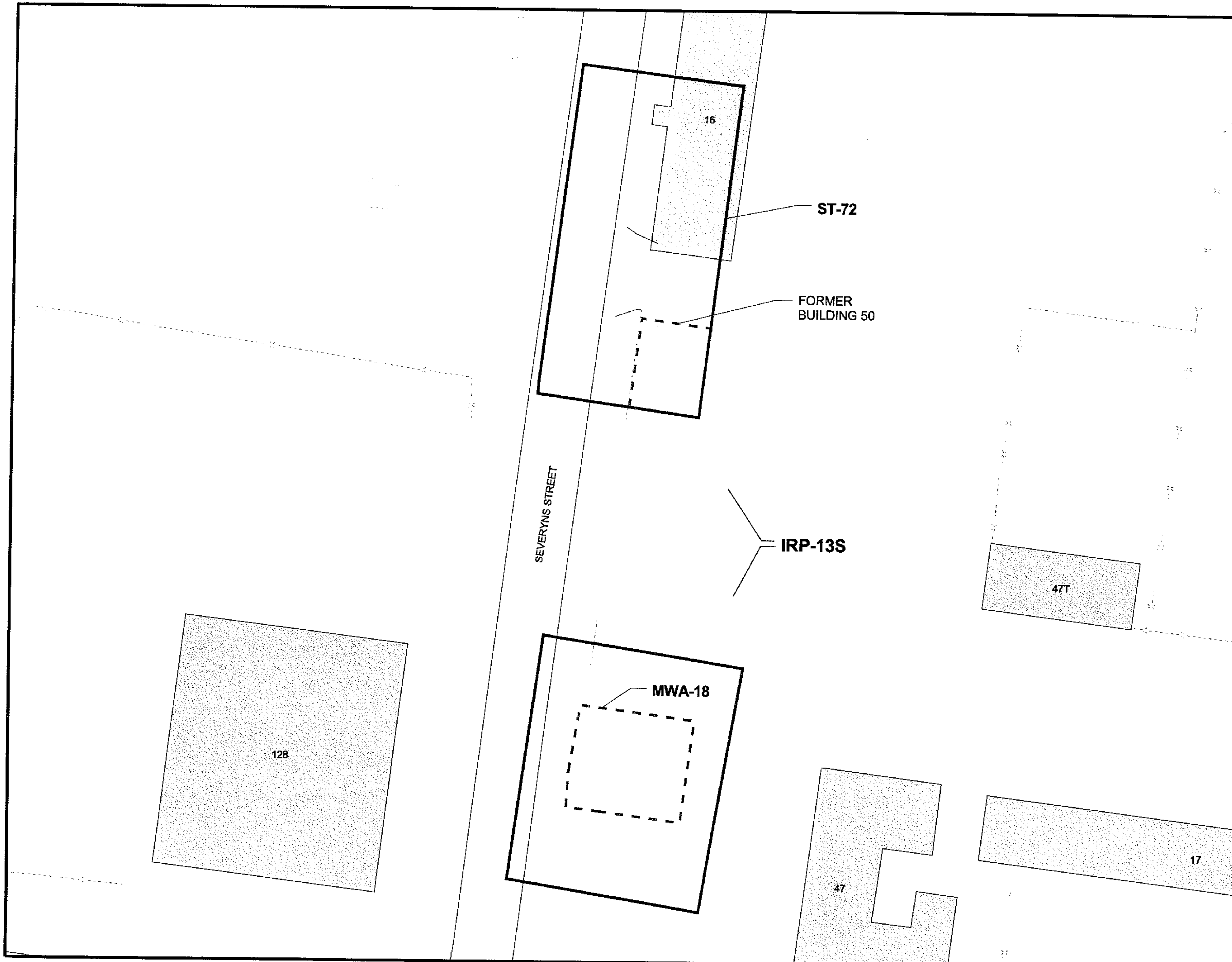
5.2.2.2 SITE INSPECTION PLAN

Following the completion of the IAS, the USMC contracted for a review of the IAS to produce the Site Inspection Plan of Action (JMM 1988a). The Site Inspection Plan of Action recommended nine IRP sites for study and amended sampling plans proposed in the IAS Report.

5.2.2.3 RCRA FACILITY ASSESSMENT REPORT, PRELIMINARY REVIEW, AND VISUAL SITE INSPECTION

Three phases of the RFA included the PR, VSI, and the sampling visit (BNI 1997a). Results of the PR and VSI conducted at ST-72 indicated that hazardous substances may have been stored, handled, disposed of, or released at the site (JEG 1992, BNI 1997b).

In 1995 and 1996, two RFA sampling visits were conducted at ST-72 that involved collection of limited field data to address uncertainties remaining from the PR and VSI regarding the extent of soil and groundwater contamination. A screening-level risk assessment and a preliminary analysis of contaminant fate and transport were also performed. The results indicated that COPCs in groundwater associated with the ST-72 source area presented unacceptable carcinogenic risk and adverse systemic effects (BNI 1997a).



Record of Decision/Remedial Action Plan

Figure 5-4

IRP-13S: ST-72 and MWA-18 Site Layout

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 3/4/04
File No.: 035L11406
Job No.: 23818-035
Rev No.: C

The first RFA sampling visit (Event 1) at ST-72 was completed between October 1995 and May 1996. Two temporary wellpoints installed in the first WBZ confirmed the presence of VOCs including TCE, 1,2,3-TCP, 1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113), and 1,1,2,2-tetrachloro-1,2-difluoroethane (Freon 112) in groundwater. 1,2,3-TCP was identified as presenting the greatest human-health risk of the VOCs encountered at ST-72. Only trace concentrations (less than 5 micrograms per kilogram [µg/kg]) of VOCs were reported in soil samples collected between the ground surface and 15 feet bgs (BNI 1997a).

In September 1996, a second step-out RFA sampling event (Event 2) was conducted to confirm the presence of 1,2,3-TCP in groundwater at ST-72 and to estimate its aerial extent in the first WBZ. Based on results from Event 2, the presence of 1,2,3-TCP, TCE, and Freon 113 in groundwater at ST-72 was confirmed. The extent of 1,2,3-TCP in groundwater was greater than previously interpreted and was not fully delineated (BNI 1997a).

On the basis of the two RFA sampling visits, the DON determined that VOC contamination in the groundwater plume originating at ST-72 extended beyond the site's boundaries and would therefore be more appropriately managed under the CERCLA program. An RI was also recommended.

5.2.2.4 REMEDIAL INVESTIGATION

An RI for ST-72, a component of IRP-13S, was conducted between October 1996 and February 1997. The scope of the RI was expanded to include MWA-18, another suspected source of VOCs released to groundwater (BNI 1997b). The RI conducted for ST-72 and MWA-18 was intended to confirm results obtained from previous RFA sampling visits, characterize geologic and hydrogeologic conditions at and downgradient of IRP-13S, determine the vertical and lateral extent of groundwater contamination, and characterize soil contamination in likely VOC source areas (BNI 1997b).

Based on the data collected during the RI, soil contamination was interpreted to exist in two distinct areas at IRP-13S: ST-72 and MWA-18. 1,2,3-TCP is the predominant soil contaminant at ST-72 (Figure 5-5). The lateral extent of 1,2,3-TCP in soil at ST-72 is encompassed by a roughly circular area, approximately 35 feet in diameter at depths of 5 to 7 feet bgs. In deeper soil samples, 10 to 15 feet bgs, the area of contamination extends horizontally to about 110 feet south of Building 16. The presence of 1,2,3-TCP in soil at ST-72, reported at concentrations up to 160 µg/kg, was attributed to past releases of cleaning solvents to the ground outside Building 16 (BNI 1997b).

TCE is the predominant contaminant at MWA-18 (Figure 5-6). Elevated concentrations of 1,2,3-TCP were only encountered at depths consistent with groundwater transport in the first WBZ from the upgradient ST-72 source area. The lateral extent of TCE reported in soil is defined by an approximately circular area centered on the former washpad (MWA-18), approximately 100 feet in diameter at 1 to 7 feet bgs and at 10 to 15 feet bgs. TCE was reported at a maximum concentration of 21,000 µg/kg in shallow soil samples collected directly beneath MWA-18 (BNI 1997b).

Other VOCs reported in soil at trace concentrations included Freon 113 and several other chlorofluorocarbon (CFC) compounds, chloroform, 1,1,1-trichloroethane (TCA), toluene, and benzene. A common TCE degradation product, 1,2-dichloroethene (DCE) , was also reported in soil at concentrations up to 140 µg/kg. Phenanthrene, a polynuclear aromatic hydrocarbon compound, was reported in four soil samples at concentrations below 10 µg/kg. Mercury was the only metal reported in soil samples at concentrations exceeding background values. Mercury was reported at concentrations from 0.16 to 1.8 milligrams per kilogram in soil samples collected from both source areas at ST-72 and MWA-18 (BNI 1997b). The RI recommended that remedial alternatives for soil and groundwater at IRP-13S be evaluated further in an FS (BNI 1997b).

5.2.2.5 POST-RI SOIL SAMPLING AND FEASIBILITY STUDY

A post-RI field program was performed in 1997 that verified the estimated distribution of TCE in soil, interpreted from data collected during the RI. No additional TCE source areas were identified (BNI 1998a).

An FS was conducted for OU-1A that included developing and evaluating remedial action alternatives for groundwater (BEI 2003b). Computer modeling performed during the FS and RI indicated that TCE remaining in soil within the vadose zone and in the upper confining layers of the first WBZ would act as a continuing source of contamination to groundwater, resulting in concentrations of TCE exceeding the maximum contaminant level (MCL). Based on soil sampling results obtained during the RI and post-RI soil sampling programs, one area with TCE concentrations in soil exceeding 400 µg/kg was identified at IRP-13S (Figures 5-6 and 5-7).

Modeling was also conducted in the FS to assess VOC transport in the saturated zone. Existing groundwater contamination in the sand layers of the first and second WBZs at IRP-13S is expected to continue migrating to the south and southwest. The FS Report concluded that without remedial action, the impacted area at Former MCAS Tustin property would expand significantly over time. VOC plumes originating at IRP-13S would eventually pass the station boundary and begin impacting Barranca Channel in about 40 years. Maximum TCE and 1,2,3-TCP concentrations of approximately 80 and 13 micrograms per liter (µg/L), respectively, would reach the drainage channel in about 70 years. VOC contamination at OU-1A would gradually diminish over time due to natural attenuation processes. However, without remedial action, TCE and 1,2,3-TCP concentrations in shallow groundwater are expected to remain above site remediation goals for over 100 years.

5.2.2.6 GROUNDWATER MONITORING

Quarterly groundwater monitoring at IRP-13S began after the RI Report was completed in 1997.

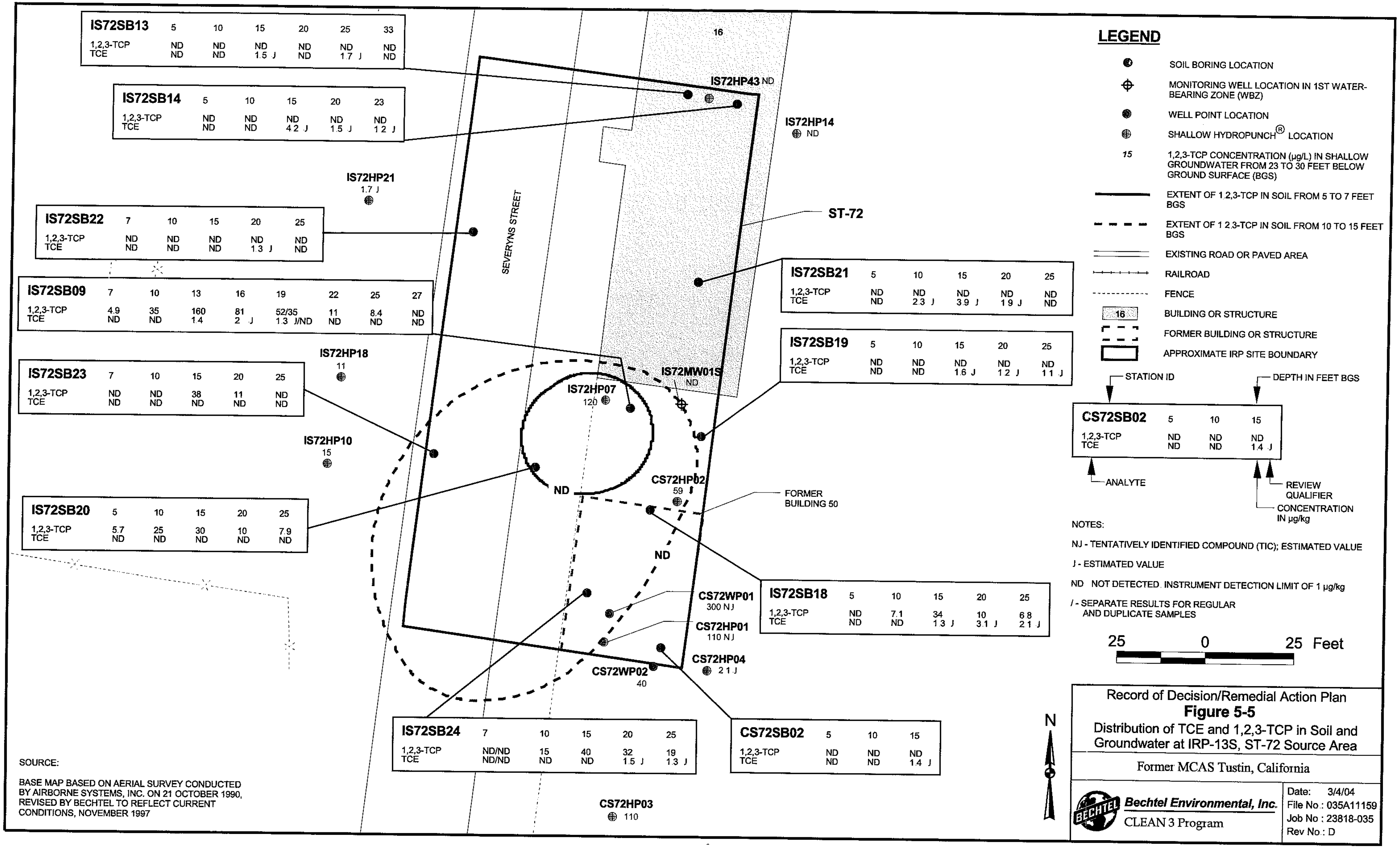


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Figure 5-5

Distribution of TCE and 1,2,3-TCP in Soil and Groundwater at IRP-13S, ST-72 Source Area

Former MCAS Tustin, California

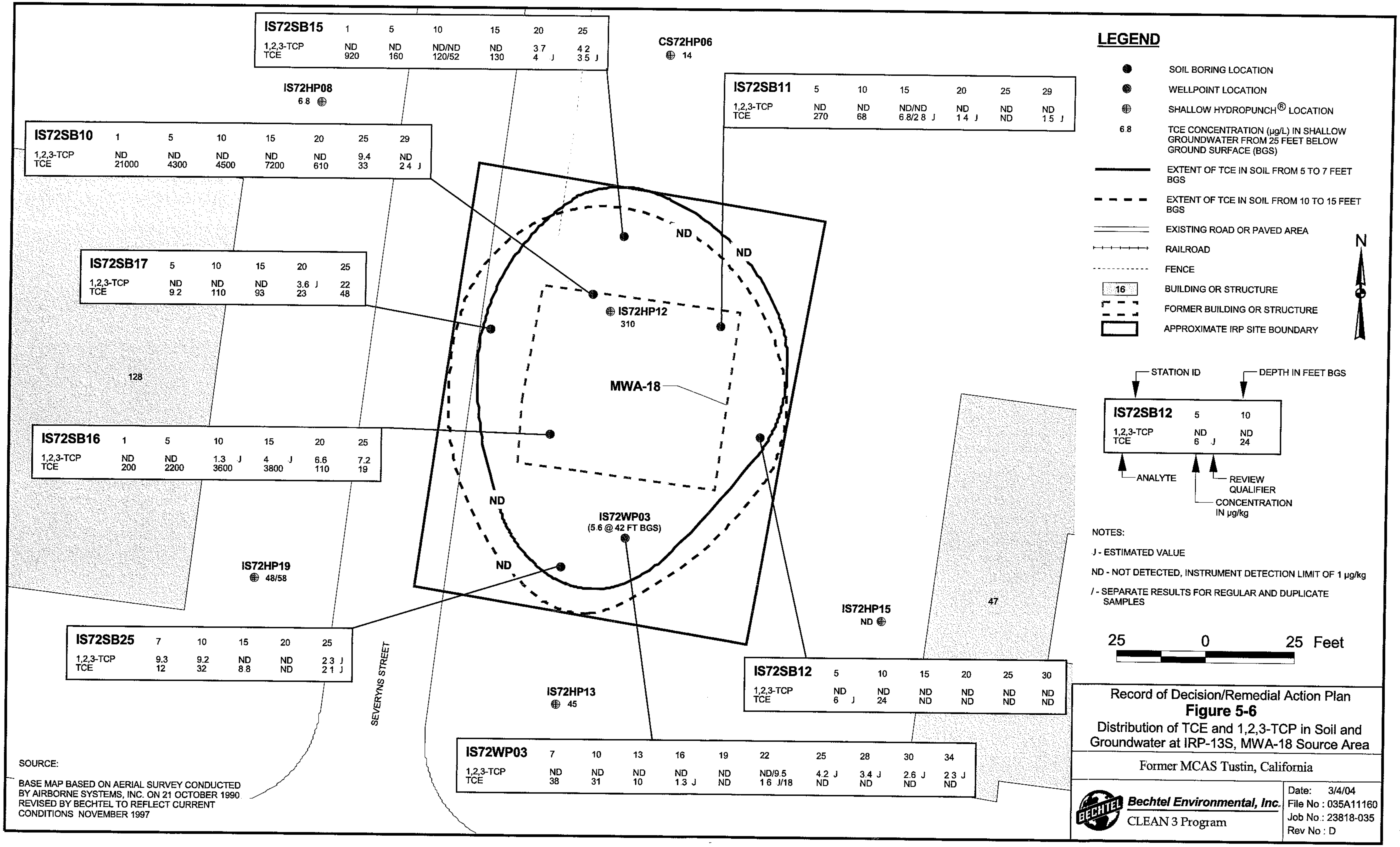
IS72SB15 1 5 10 15 20 25
1,2,3-TCP ND ND ND/ND ND 3 7 4 2
TCE 920 160 120/52 130 4 J 3 5 J
CS72HP06
14
IS72HP08
6 8
IS72SB11 5 10 15 20 25 29
1,2,3-TCP ND ND ND/ND ND ND ND
TCE 270 68 6 8/2 8 J 1 4 J ND 1 5 J
IS72SB10 1 5 10 15 20 25 29
1,2,3-TCP ND ND ND ND ND 9.4 ND
TCE 21000 4300 4500 7200 610 33 2 4 J
IS72SB17 5 10 15 20 25
1,2,3-TCP ND ND ND 3.6 J 22
TCE 9 2 110 93 23 48
ND
ND
IS72HP12
310
128
MWA-18
IS72SB16 1 5 10 15 20 25
1,2,3-TCP ND ND 1.3 J 4 J 6.6 7.2
TCE 200 2200 3600 3800 110 19
ND
IS72WP03
(5.6 @ 42 FT BGS)
IS72HP19
48/58
ND
IS72HP15
ND
47
IS72SB25 7 10 15 20 25
1,2,3-TCP 9.3 9.2 ND ND 2 3 J
TCE 12 32 8 8 ND 2 1 J
SEVERYNS STREET
IS72SB12 5 10 15 20 25 30
1,2,3-TCP ND ND ND ND ND ND
TCE 6 J 24 ND ND ND ND
IS72HP13
45
IS72WP03 7 10 13 16 19 22 25 28 30 34
1,2,3-TCP ND ND ND ND ND ND/9.5 4.2 J 3.4 J 2.6 J 2 3 J
TCE 38 31 10 1 3 J ND 1 6 J/18 ND ND ND ND
LEGEND
SOIL BORING LOCATION
WELLPOINT LOCATION
SHALLOW HYDROPUNCH® LOCATION
6 8 TCE CONCENTRATION (µg/L) IN SHALLOW GROUNDWATER FROM 25 FEET BELOW GROUND SURFACE (BGS)
EXTENT OF TCE IN SOIL FROM 5 TO 7 FEET BGS
EXTENT OF TCE IN SOIL FROM 10 TO 15 FEET BGS
EXISTING ROAD OR PAVED AREA
RAILROAD
FENCE
16 BUILDING OR STRUCTURE
FORMER BUILDING OR STRUCTURE
APPROXIMATE IRP SITE BOUNDARY
N
STATION ID
DEPTH IN FEET BGS
IS72SB12 5 10
1,2,3-TCP ND ND
TCE 6 J 24
ANALYTE
REVIEW QUALIFIER
CONCENTRATION IN µg/kg
NOTES:
J - ESTIMATED VALUE
ND - NOT DETECTED, INSTRUMENT DETECTION LIMIT OF 1 µg/kg
/ - SEPARATE RESULTS FOR REGULAR AND DUPLICATE SAMPLES
25 0 25 Feet
SOURCE:
BASE MAP BASED ON AERIAL SURVEY CONDUCTED BY AIRBORNE SYSTEMS, INC. ON 21 OCTOBER 1990 REVISED BY BECHTEL TO REFLECT CURRENT CONDITIONS NOVEMBER 1997
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Figure 5-6
Distribution of TCE and 1,2,3-TCP in Soil and Groundwater at IRP-13S, MWA-18 Source Area
Former MCAS Tustin, California
Bechtel Environmental, Inc.
CLEAN 3 Program
Date: 3/4/04
File No : 035A11160
Job No : 23818-035
Rev No : D

Record of Decision/Remedial Action Plan

Figure 5-7

Approximate Extent of TCE Soil Contamination > 400 µg/kg at IRP-13S

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 3/4/04
File No : 035L11483
Job No : 23818-035
Rev No : B

VOC Plume at IRP-13S

1,2,3-TCP was reported in groundwater samples from the third WBZ during the September and December 1997 monitoring rounds. In 1998, a limited deep HydroPunch investigation was conducted to evaluate potential mechanisms for migration of 1,2,3-TCP into the third WBZ and to determine the direction of groundwater flow and the extent of 1,2,3-TCP in the third WBZ at IRP-13S (BNI 1999c). As part of this investigation, three new monitoring wells were installed in crossgradient and downgradient limits of the 1,2,3-TCP plume in the third WBZ.

On the basis of quarterly groundwater monitoring conducted from 1997 through 2001 and summarized in the 2001 Annual Groundwater Monitoring Report for Former MCAS Tustin, VOCs in groundwater originating at IRP-13S have been identified in all three WBZs (Figures 5-8 through 5-11).

Figure 5-9 shows the lateral extent of the 1,2,3-TCP plume in the first WBZ at concentrations exceeding 1.0 µg/L based on quarterly groundwater monitoring data collected during 2001. The 1,2,3-TCP plume extends approximately 2,400 feet south-southwest from the source area at IRP-13S and is approximately 600 feet across at its widest point. The maximum reported concentration of 1,2,3-TCP (85 µg/L) in groundwater from the sand layer of the first WBZ was from a sample collected during the fall 2001 monitoring round from a well located approximately 700 feet downgradient of Building 16 (BEI 2003a). From 1997 through 2001, the extent of 1,2,3-TCP in the first WBZ has remained relatively stable based on quarterly monitoring results (BEI 2003a).

Figure 5-10 shows the lateral extent of 1,2,3-TCP in the second WBZ at concentrations exceeding 1.0 µg/L. The 1,2,3-TCP plume extends approximately 2,100 feet downgradient from the source area at ST-72 and is approximately 650 feet wide. 1,2,3-TCP in the second WBZ underlies the footprint of the 1,2,3-TCP plume in the first WBZ (BNI 1997b). The maximum reported concentration of 1,2,3-TCP (160 µg/L) in groundwater from the second WBZ was from a deep HydroPunch groundwater sample collected in late 1996 approximately 700 feet downgradient from Building 16.

From 1997 through 2001, the extent of 1,2,3-TCP in the second WBZ remained relatively stable, based on monitoring results (BEI 2003a).

In the third WBZ, 1,2,3-TCP is interpreted to exist in a localized area, approximately 1,500 feet downgradient from the source area at Building 16 (Figure 5-11). The maximum reported concentration of 1,2,3-TCP (50 µg/L) in the third WBZ was reported in a groundwater sample from well IS72MW7D2 during the spring 2001 monitoring round. TCE in groundwater originating from MWA-18 occurs with 1,2,3-TCP in the first WBZ. Trace concentrations of 1,2-DCE, a breakdown product of TCE, were also reported in groundwater underlying MWA-18. Other VOCs reported in groundwater at IRP-13S include 1,1,1-TCA, chloroform, acetone, methyl ethyl ketone, CFCs, and toluene, all at generally low concentrations (BNI 1997b, 2002). Based on RI monitoring data, hexavalent chromium was the only metal reported in groundwater at concentrations (3 to 5 µg/L) exceeding background values (BNI 1997b). Based on data obtained during the RI and subsequent groundwater monitoring, two primary COPCs were identified: TCE and 1,2,3-TCP.

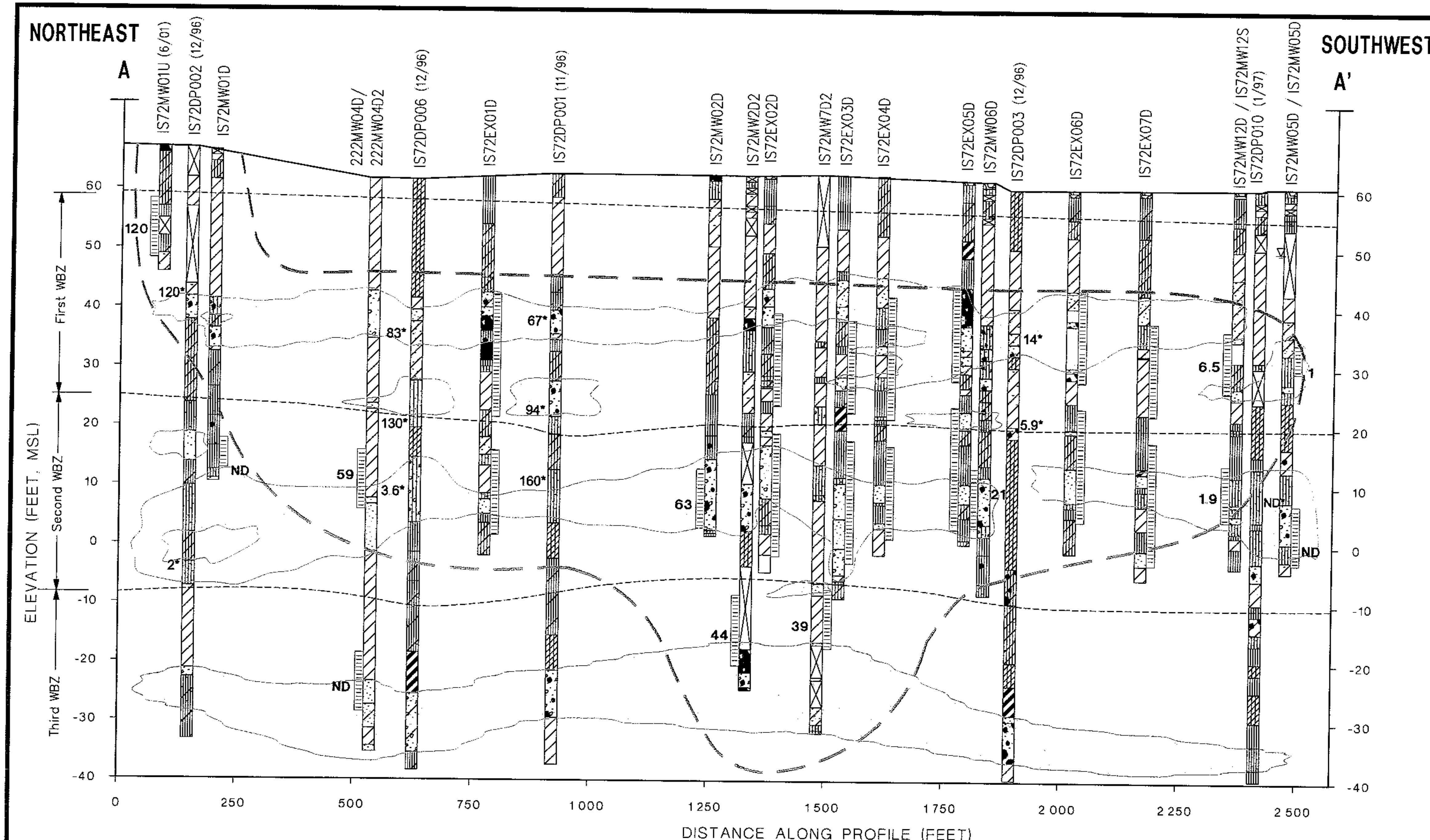
MTBE Plume (Addressed Under the PCAP)

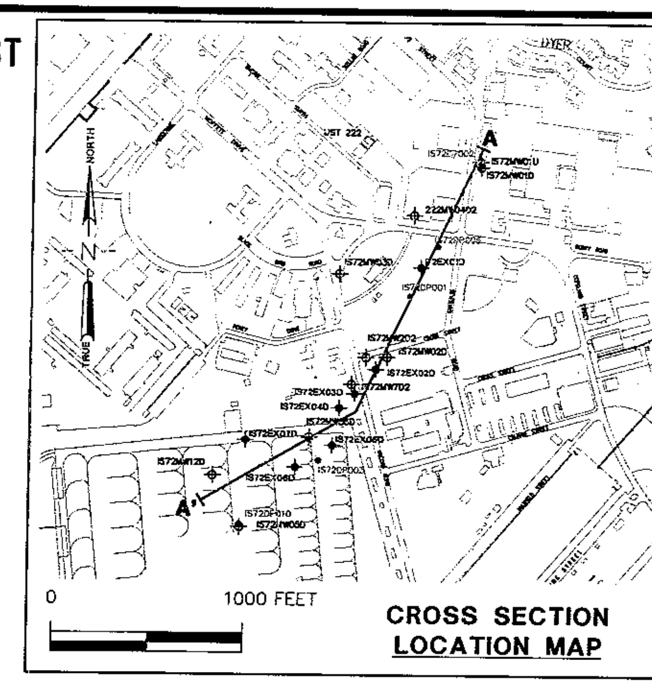
MTBE, a gasoline additive, was first identified in groundwater samples collected at IRP-13S in 1997. Based on data presented in the 2001 Annual Groundwater Monitoring Report, MTBE from adjacent UST Site 222 commingles with 1,2,3-TCP in the first and second WBZs at IRP-13S (BEI 2003a). MTBE was reported at a maximum concentration of 62,000 µg/L in groundwater samples collected from wells located on the western boundary of the IRP-13S plumes in the first and second WBZs (BEI 2003a) (Figures 5-9 and 5-10). Further fieldwork to delineate the source and extent of MTBE contamination was conducted under the DON's PCAP. This work suggested that UST Site 222 is the MTBE source area. This UST was located west of IRP-13S at a former service station. A removal action to address the contamination originating at UST Site 222 is being managed by the DON under the PCAP. Activities associated with the removal action are being closely coordinated with activities associated with the TCRA groundwater treatment system currently operating at IRP-13S. Similarly, the remedy for IRP-13S will require coordination of the MTBE cleanup activities with aspects of the overall design.

In a 09 March 2001 letter to the BCT, the DON indicated that MTBE contamination from UST Site 222 would be addressed under the PCAP, a separate compliance program, and a TCRA would be implemented at IRP-13S to address 1,2,3-TCP in groundwater. Cleanup of the MTBE plume is not addressed as part of the groundwater cleanup at OU-1A.

5.2.2.7 TIME-CRITICAL REMOVAL ACTION AT IRP-13S

Interim removal of groundwater under a TCRA system installed at IRP-13S began in January 2002 and is ongoing. The purpose of the TCRA system was to initiate hydraulic containment of groundwater contaminated with 1,2,3-TCP within present plume boundaries in the first and second WBZs to minimize further vertical and/or horizontal migration until the final remedy is implemented or plume migration is stabilized. Contractors (initially Bechtel National, Inc.) operating the TCRA system work closely with Shaw Environmental, Inc., who is operating a treatment system for remediation of groundwater contaminated with MTBE from UST Site 222 under the PCAP. Close coordination is necessary to assure that groundwater extraction is balanced and not resulting in crossgradient migration and further commingling of the two plumes. Changes in water-level elevation are also monitored over time to evaluate the impact of pumping on shallow groundwater in the vicinity of the commingled plumes. Results from quarterly groundwater monitoring conducted during summer 2002 indicate the TCRA system is effectively containing the VOC plumes (PTES 2002).





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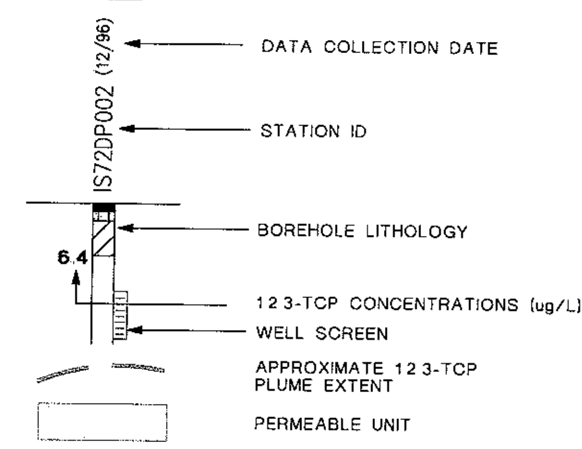

NOTES:

ND - NOT REPORTED
1,2,3-TCP - TRICHLOROPROPANE
MTBE - METHYL TERT-BUTYL ETHER
ug/L - MICROGRAMS PER LITER
★ - DATA FROM HYDROPUNCH SAMPLE

1,2,3-TCP AND MTBE CONCENTRATIONS FROM WINTER 2001 GROUNDWATER MONITORING ROUND UNLESS NOTED OTHERWISE

LEGEND

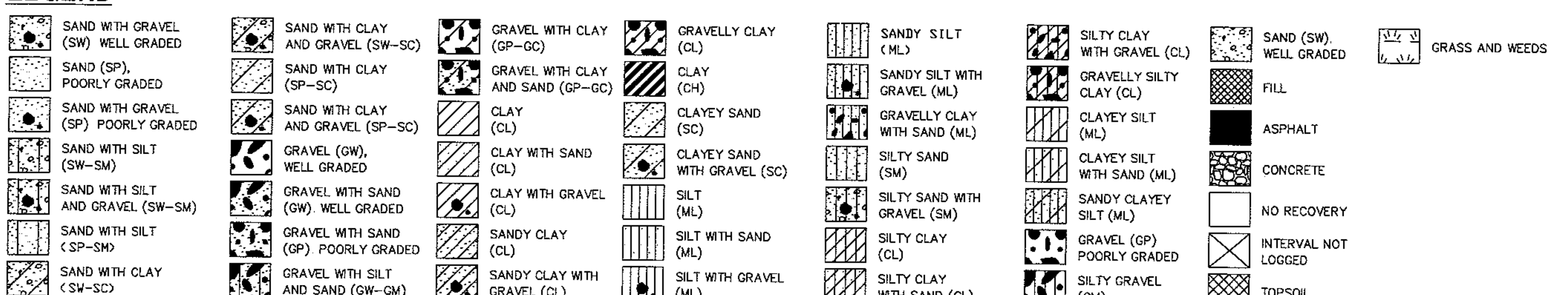

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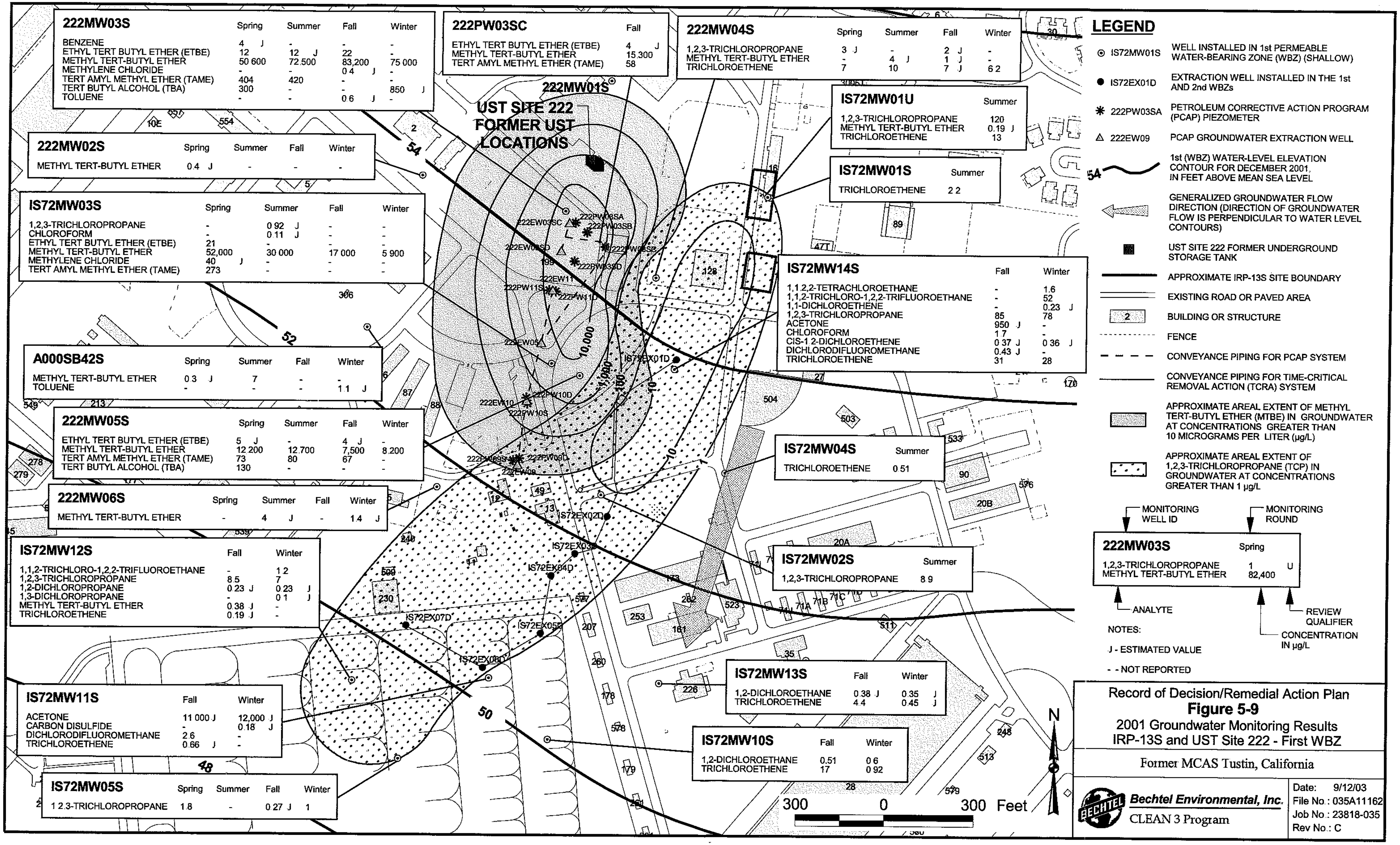
Figure 5-8

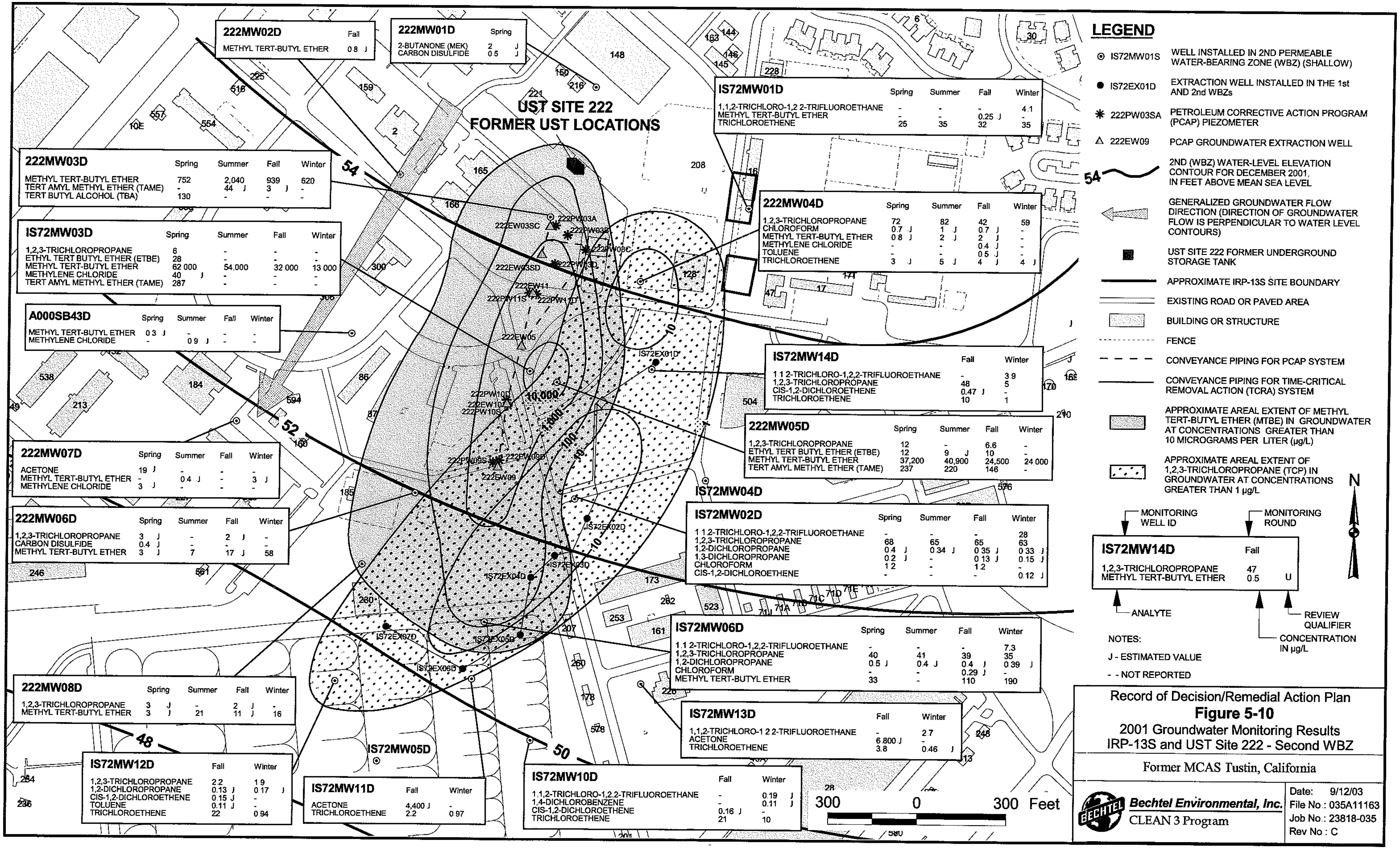
Vertical Extent of 1,2,3-TCP in Groundwater at IRP-13S and UST Site 222

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 9/12/03
File No: 035X11161
Job No: 23818-035
Rev No: C


222MW03S Spring Summer Fall Winter
BENZENE 4 J - - -
ETHYL TERT BUTYL ETHER (ETBE) 12 12 J 22 -
METHYL TERT-BUTYL ETHER 50 600 72 500 83,200 75 000
METHYLENE CHLORIDE - - 0 4 J -
TERT AMYL METHYL ETHER (TAME) 404 420 - -
TERT BUTYL ALCOHOL (TBA) 300 - - 850 J
TOLUENE - - 0 6 J -
222PW03SC Fall
ETHYL TERT BUTYL ETHER (ETBE) 4 J
METHYL TERT-BUTYL ETHER 15,300
TERT AMYL METHYL ETHER (TAME) 58
222MW04S Spring Summer Fall Winter
1,2,3-TRICHLOROPROPANE 3 J - 2 J -
METHYL TERT-BUTYL ETHER - 4 J 1 J -
TRICHLOROETHENE 7 10 7 J 6 2
IS72MW01U Summer
1,2,3-TRICHLOROPROPANE 120
METHYL TERT-BUTYL ETHER 0.19 J
TRICHLOROETHENE 13
IS72MW01S Summer
TRICHLOROETHENE 2 2
222MW02S Spring Summer Fall Winter
METHYL TERT-BUTYL ETHER 0.4 J - - -
IS72MW03S Spring Summer Fall Winter
1,2,3-TRICHLOROPROPANE - 0 92 J - -
CHLOROFORM - 0 11 J - -
ETHYL TERT BUTYL ETHER (ETBE) 21 - - -
METHYL TERT-BUTYL ETHER 52,000 30 000 17 000 5 900
METHYLENE CHLORIDE 40 J - - -
TERT AMYL METHYL ETHER (TAME) 273 - - -
IS72MW14S Fall Winter
1,1,2,2-TETRACHLOROETHANE - 1.6
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE - 52
1,1-DICHLOROETHENE - 0.23 J
1,2,3-TRICHLOROPROPANE 85 78
ACETONE 950 J -
CHLOROFORM 1 7 -
CIS-1 2-DICHLOROETHENE 0 37 J 0 36 J
DICHLORODIFLUOROMETHANE 0.43 J -
TRICHLOROETHENE 31 28
A000SB42S Spring Summer Fall Winter
METHYL TERT-BUTYL ETHER 0 3 J 7 - -
TOLUENE - - - 1 1 J
222MW05S Spring Summer Fall Winter
ETHYL TERT BUTYL ETHER (ETBE) 5 J - 4 J -
METHYL TERT-BUTYL ETHER 12 200 12 700 7,500 8 200
TERT AMYL METHYL ETHER (TAME) 73 80 67 -
TERT BUTYL ALCOHOL (TBA) 130 - - -
IS72MW04S Summer
TRICHLOROETHENE 0 51
222MW06S Spring Summer Fall Winter
METHYL TERT-BUTYL ETHER - 4 J - 1 4 J
IS72MW12S Fall Winter
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE - 1 2
1,2,3-TRICHLOROPROPANE 8 5 7
1,2-DICHLOROPROPANE 0 23 J 0 23 J
1,3-DICHLOROPROPANE - 0 1 J
METHYL TERT-BUTYL ETHER 0 38 J -
TRICHLOROETHENE 0.19 J -
IS72MW02S Summer
1,2,3-TRICHLOROPROPANE 8 9
IS72MW13S Fall Winter
1,2-DICHLOROETHANE 0 38 J 0 35 J
TRICHLOROETHENE 4 4 0 45 J
IS72MW11S Fall Winter
ACETONE 11 000 J 12,000 J
CARBON DISULFIDE - 0 18 J
DICHLORODIFLUOROMETHANE 2 6 -
TRICHLOROETHENE 0.66 J -
IS72MW10S Fall Winter
1,2-DICHLOROETHANE 0.51 0 6
TRICHLOROETHENE 17 0 92
IS72MW05S Spring Summer Fall Winter
1 2 3-TRICHLOROPROPANE 1 8 - 0 27 J 1
UST SITE 222 FORMER UST LOCATIONS
222MW01S
54
52
50
48
10,000
1,000
100
10
1
LEGEND
IS72MW01S WELL INSTALLED IN 1st PERMEABLE WATER-BEARING ZONE (WBZ) (SHALLOW)
IS72EX01D EXTRACTION WELL INSTALLED IN THE 1st AND 2nd WBZs
222PW03SA PETROLEUM CORRECTIVE ACTION PROGRAM (PCAP) PIEZOMETER
222EW09 PCAP GROUNDWATER EXTRACTION WELL
54 1st (WBZ) WATER-LEVEL ELEVATION CONTOUR FOR DECEMBER 2001, IN FEET ABOVE MEAN SEA LEVEL
GENERALIZED GROUNDWATER FLOW DIRECTION (DIRECTION OF GROUNDWATER FLOW IS PERPENDICULAR TO WATER LEVEL CONTOURS)
UST SITE 222 FORMER UNDERGROUND STORAGE TANK
APPROXIMATE IRP-13S SITE BOUNDARY
EXISTING ROAD OR PAVED AREA
2 BUILDING OR STRUCTURE
FENCE
CONVEYANCE PIPING FOR PCAP SYSTEM
CONVEYANCE PIPING FOR TIME-CRITICAL REMOVAL ACTION (TCRA) SYSTEM
APPROXIMATE AREAL EXTENT OF METHYL TERT-BUTYL ETHER (MTBE) IN GROUNDWATER AT CONCENTRATIONS GREATER THAN 10 MICROGRAMS PER LITER (μg/L)
APPROXIMATE AREAL EXTENT OF 1,2,3-TRICHLOROPROPANE (TCP) IN GROUNDWATER AT CONCENTRATIONS GREATER THAN 1 μg/L
MONITORING WELL ID
MONITORING ROUND
222MW03S Spring
1,2,3-TRICHLOROPROPANE 1 U
METHYL TERT-BUTYL ETHER 82,400
ANALYTE
REVIEW QUALIFIER
CONCENTRATION IN μg/L
NOTES:
J - ESTIMATED VALUE
- - NOT REPORTED
300 0 300 Feet
N
Record of Decision/Remedial Action Plan
Figure 5-9
2001 Groundwater Monitoring Results
IRP-13S and UST Site 222 - First WBZ
Former MCAS Tustin, California
Bechtel Environmental, Inc.
CLEAN 3 Program
Date: 9/12/03
File No : 035A11162
Job No : 23818-035
Rev No : C



Record of Decision/Remedial Action Plan

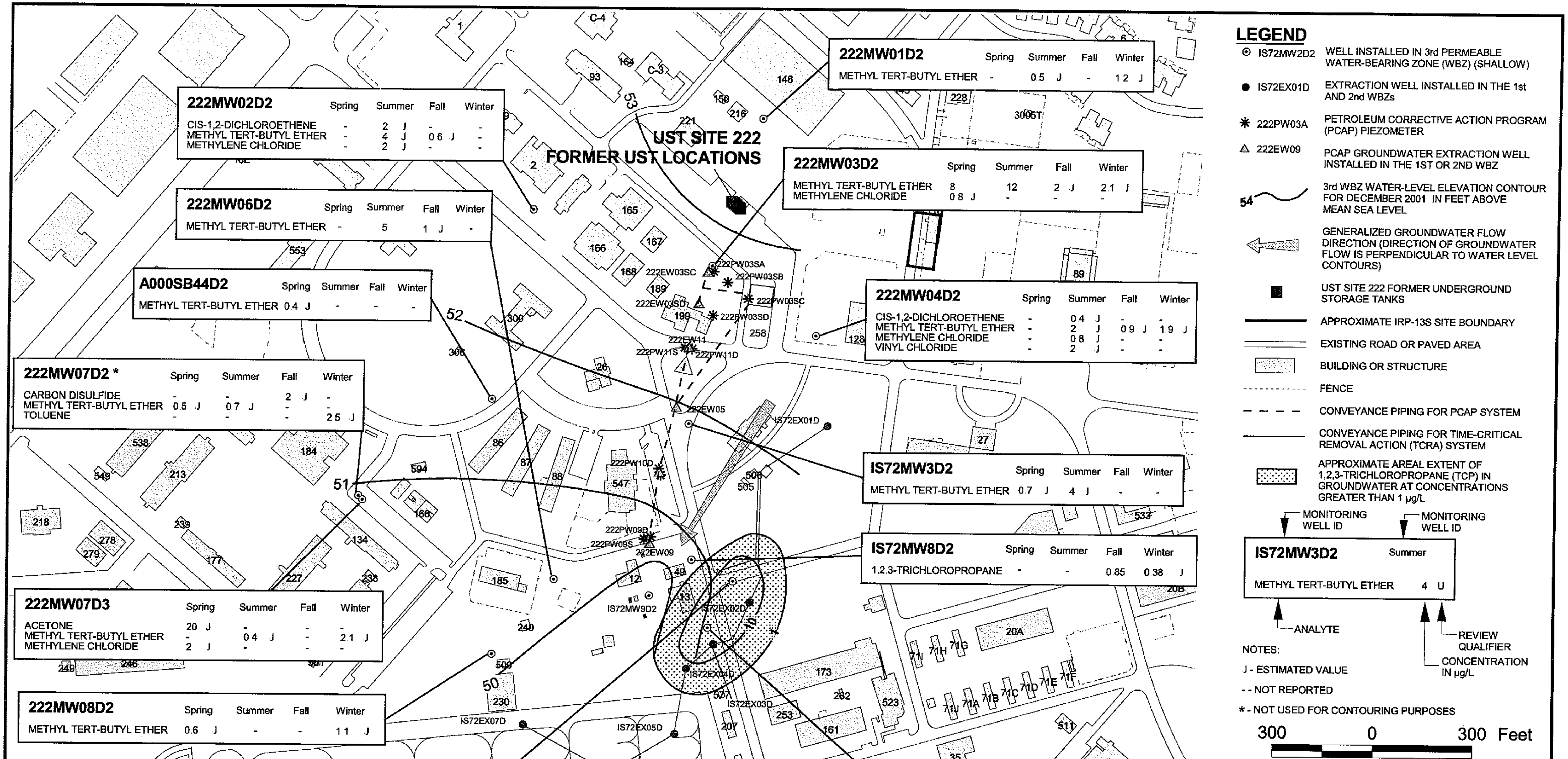
Figure 5-10

2001 Groundwater Monitoring Results
IRP-13S and UST Site 222 - Second WBZ

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 9/12/03
File No.: 035A11163
Job No.: 23818-035
Rev No.: C



Record of Decision/Remedial Action Plan

Figure 5-11

2001 Groundwater Monitoring Results
IRP-13S and UST Site 222 - Third WBZ

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 3/8/04
File No.: 035A11164
Job No.: 23818-035
Rev No.: D

A total of seven extraction and ten groundwater monitoring wells were installed in both the first and second WBZs. The system was designed to extract groundwater at approximately 35 gallons per minute (gpm). Extracted groundwater is pumped to the treatment system via buried and aboveground pipelines and is treated using a dual-stage granular activated carbon (GAC) adsorption system. Influent water is prefiltered using bag filters to remove entrained sediments and other materials that could cause fouling, prior to being pumped through two (in-series) 2,000-pound GAC filters. Clean, treated water is then discharged to a nearby storm drain located at the corner of Cross Street and McCord Road. Clean effluent water is sampled weekly to ensure compliance with the substantive provisions of National Pollutant Discharge Elimination System (NPDES) Permit No. CAG918001. Components of the TCRA system (e.g., extraction wells, treatment compound, and piping) may be incorporated into the final remedy depending on the compatibility of the components with the final remedy, which will be determined during the remedial design phase.

5.3 EXPOSURE PATHWAYS

Currently, no human population is exposed to VOC-contaminated groundwater in the first or second WBZ at Former MCAS Tustin. However, as the former station is redeveloped for civilian use, potential future receptors and exposure pathways must be considered.

Exposure pathways for COPCs in soil at IRP-13S include ingestion, inhalation, and dermal contact (Figure 5-12). Exposure pathways were identified based on site-specific information, physical properties of COPCs, and human receptors corresponding to future land use planned by the city of Tustin (BNI 1997b). Section 6 summarizes current and future land and resource uses, and Section 7 summarizes risks associated with routes of exposure.

Releases of VOCs (mainly 1,2,3-TCP and TCE), associated with activities at MWA-18 and ST-72, migrated through the soil to groundwater in the first WBZ. Over the years, VOC contaminants have migrated horizontally and downward through hydraulic connections between the first and second WBZs. VOCs have also migrated from the second to the third WBZ by way of a localized hydraulic connection approximately 1,500 feet downgradient from where the releases of VOCs occurred (Figures 5-8 through 5-11).

TCE and 1,2,3-TCP are the predominant VOCs reported in groundwater and soil at IRP-13S (BNI 1997b). VOCs are typically reported at very low concentrations in vadose zone soils at the site. Results from previous soil sampling for VOCs in the vadose zone are presented on Figures 5-5 and 5-6. Maximum reported VOC concentrations were identified in a relatively thick, low-permeability, silty clay layer below the top of the water table referred to as the upper confining layer of the first WBZ. This upper confining layer is approximately 20 feet thick and lies immediately above a more permeable silty sand layer in the first WBZ at IRP-13S (Figure 5-8).

Contaminants remain bound in the fine-grained soil of the upper confining layer of the first WBZ due to the tendency of clays to adsorb chlorinated VOCs. The presence of sorbed and dissolved VOCs in the upper clay layer provides a potential long-term source of contamination to the deeper portions of the shallow aquifer system (BNI 1997b). Therefore, direct exposure to chemicals in the subsurface would not occur unless excavation activities exposed contaminated soils at the surface.

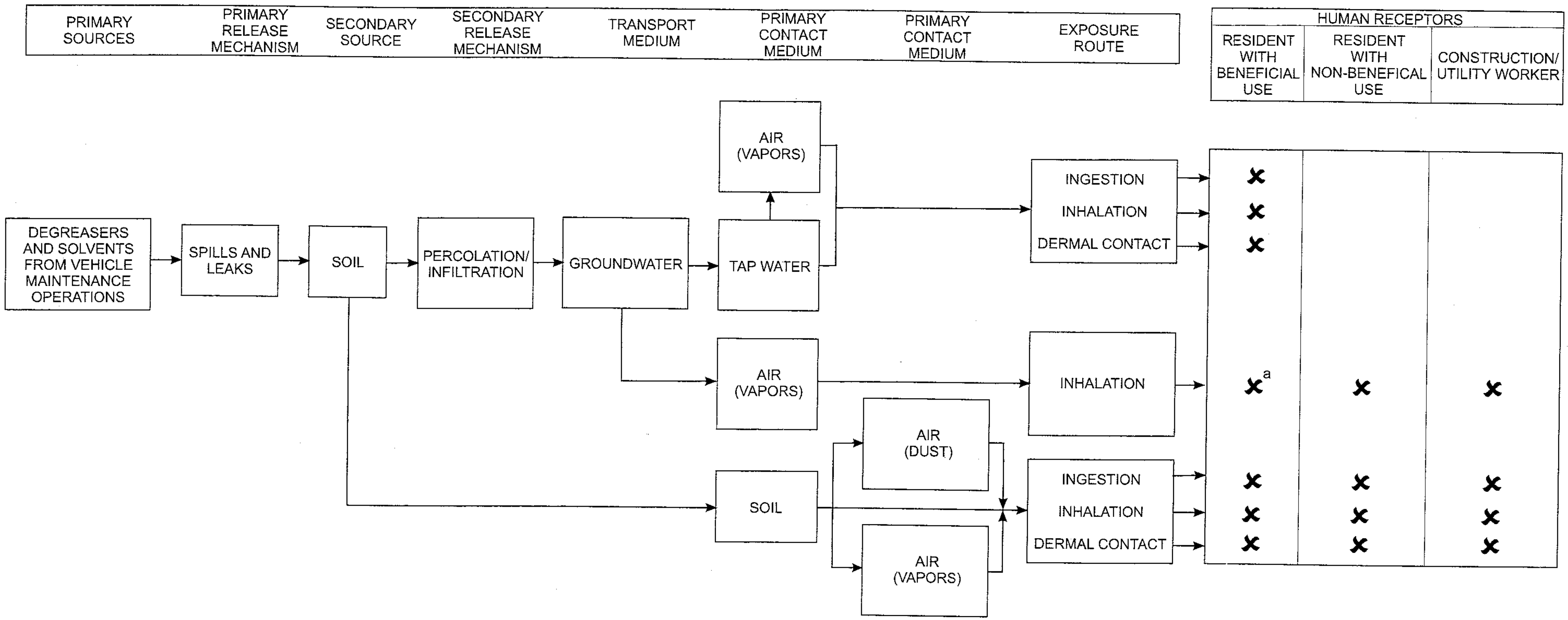
Net groundwater infiltration rates at Former MCAS Tustin are generally low, typically less than 0.5 inch per year. Therefore, there is no driving force to promote the downward migration of VOCs in the shallow aquifer system. However, infiltration rates on the order of 10 inches per year in localized areas at IRP-13S may have been responsible for the vertical migration of TCE and 1,2,3-TCP to maximum depths of approximately 60 feet bgs (BNI 1997b). A potential explanation for higher localized groundwater infiltration rates is the former routine disposal of washwater outside of Building 16 at ST-72 and on the washpad at MWA-18.

Groundwater remediation would be much more difficult if TCE and 1,2,3-TCP were present in the subsurface as dense nonaqueous-phase liquids (DNAPLs). Site characterization data were, therefore, evaluated to assess the potential for the existence of DNAPLs at the site. Data from the site were compared to criteria developed by U.S. EPA as generic DNAPL indicators in soil and groundwater (U.S. EPA 1991). A review of data presented in the RI Report indicates that TCE and 1,2,3-TCP do not meet criteria that would indicate DNAPLs in soil or groundwater (BNI 1997b).

The conceptual model developed during the RI for IRP-13S suggests that VOC contamination originating at or near the surface entered groundwater through the vadose zone in dissolved form. Much of the contaminant mass remaining in the subsurface has been retained in the upper confining layer of the first WBZ, although dissolved VOCs have migrated vertically into the sand layer of the first WBZ as well as into the second WBZ. Other than one localized area downgradient of IRP-13S, there is no evidence suggesting a pathway for the contaminant plumes at Former MCAS Tustin to migrate into the third WBZ or into the deeper regional aquifer (BNI 1997b, 1999c). Currently, there is no complete exposure pathway to contaminated groundwater at IRP-13S; groundwater from the first and second WBZs is not being used for any purpose. However, groundwater remains a potential future route of exposure because it could, in theory, be used for domestic purposes.

5.4 MASS OF VOCs

The estimated total mass of TCE and 1,2,3-TCP in the first WBZ at IRP-13S is approximately 3.1 and 13.5 pounds, respectively (Table 5-1). The estimated total mass of 1,2,3-TCP in the second WBZ at IRP-13S is approximately 6.4 pounds (Table 5-1). These estimates were based on data collected during the RI (BNI 1997b) and on groundwater modeling conducted during the FS (BEI 2003b). It is estimated that much of the TCE and 1,2,3-TCP mass remaining in the subsurface is contained within the upper confining layer of the first WBZ, although dissolved VOCs have also migrated vertically downward into the sand layer of the first WBZ as well as into the second WBZ.



[a]DOMESTIC VAPOR PHASE CONCENTRATIONS ARE CONSIDERABLY HIGHER THAN THOSE TRANSFERRED VIA GROUNDWATER

Record of Decision/Remedial Action Plan

Figure 5-12

Potential Routes of Exposure for OU-1A

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 3/9/04
File No: 035C11166
Job No: 23818-035
Rev No: D

Table 5-1
Estimated OU-1A Plume Dimensions,
Maximum VOC Concentrations, and VOC Mass

WBZ	Area (square feet)	Maximum TCE Concentration* (µg/L)	TCE Mass (pounds)	Maximum 1,2,3-TCP Concentration* (µg/L)	1,2,3-TCP Mass (pounds)
First	996,000	310	3.1	340	13.5
Second	932,000	ND	NA	160	6.4
Total Mass			**3.1**		**19.9**

Note:
* maximum reported concentrations in the sand layers of the first and second WBZs; contamination reported in the third WBZ is considered insignificant based on the limited areal extent and low concentrations

Acronyms/Abbreviations:
- µg/L – micrograms per liter
- NA – not applicable
- ND – not detected
- OU – operable unit
- TCE – trichloroethene
- TCP – trichloropropane
- VOC – volatile organic compound
- WBZ – water-bearing zone

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Section 6
CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

This section discusses the current and reasonably anticipated future land uses and current and potential groundwater and surface water uses at Former MCAS Tustin. Examining uses of the site and its resources helps formulate realistic exposure scenarios in the baseline risk assessment.

6.1 LAND USES

The Former MCAS Tustin property was determined to be excess to the long-term needs of the USMC. It was therefore decided to transfer the property to other federal agencies and/or nonfederal interests for redevelopment and reuse.

In November 1993, the DON organized the BCT to manage and coordinate facilitywide cleanup and closure activities in order to expedite land transfer at Former MCAS Tustin. DTSC is the lead regulatory agency overseeing environmental restoration at the station. U.S. EPA and the RWQCB Santa Ana Region are also participating members of the BCT.

The city of Tustin has been recognized by the U.S. Department of Defense as the LRA responsible for reuse planning at Former MCAS Tustin. In September 1998, the LRA prepared an SP errata updating the 1996 SP, which designates the preferred reuse and transfer mechanism for each parcel at the station. The SP was approved by the U.S. Department of Housing and Urban Development (HUD) on 24 March 1998. The MCAS Tustin SP was adopted by the Tustin City Council on 03 February 2003.

The LRA and the USMC prepared a joint federal Environmental Impact Statement (EIS) and state Environmental Impact Report (EIR) to address potential environmental issues associated with the planned reuse of Former MCAS Tustin. The EIS/EIR was developed in accordance with the National Environmental Policy Act and the California Environmental Quality Act. The final EIS/EIR was issued in December 1999 (DON 1999).

As noted in the BRAC Cleanup Plan (SWDIV 1998), the SP is the cornerstone of the environmental restoration strategy at Former MCAS Tustin. Figure 6-1 shows Carve-Out Area 5, which surrounds OU-1A, including the VOC groundwater plume. Portions of this area are, or will be, leased while cleanup activities are taking place. Reuse designations at Former MCAS Tustin include commercial and residential areas, schools and child-care facilities, parks, and recreational facilities. Future land use for areas defined as "community core" by the city of Tustin may include residential, commercial, and/or other uses identified within the approved SP.

The city's reuse plan for Former MCAS Tustin was the basis for the HHRA completed to support the RI (BNI 1997b). Future land use was also a key consideration throughout this ROD/RAP in the development and analysis of OU-1A remedial alternatives. For areas designated as "community core," it was assumed that remediation would have to be adequate to support residential redevelopment, generally considered the most sensitive reuse option.

On 02 July 1999, Former MCAS Tustin was closed, and the USMC's mission at the station was incorporated into MCAS Miramar operations in San Diego, California. Access to the station is currently controlled by security services. Services are maintained as necessary to provide support for caretaker, lessee, and environmental cleanup operations Most of the buildings are unoccupied.

The IRP-13S source area is situated on land identified in the SP as Parcel No. 24, which has been designated by the city of Tustin for residential redevelopment (City of Tustin 1998). The groundwater plumes originating at IRP-13S extend downgradient from the source area under several other redevelopment parcels. These downgradient parcels and their respective reuse designations are as follows (City of Tustin 1996):

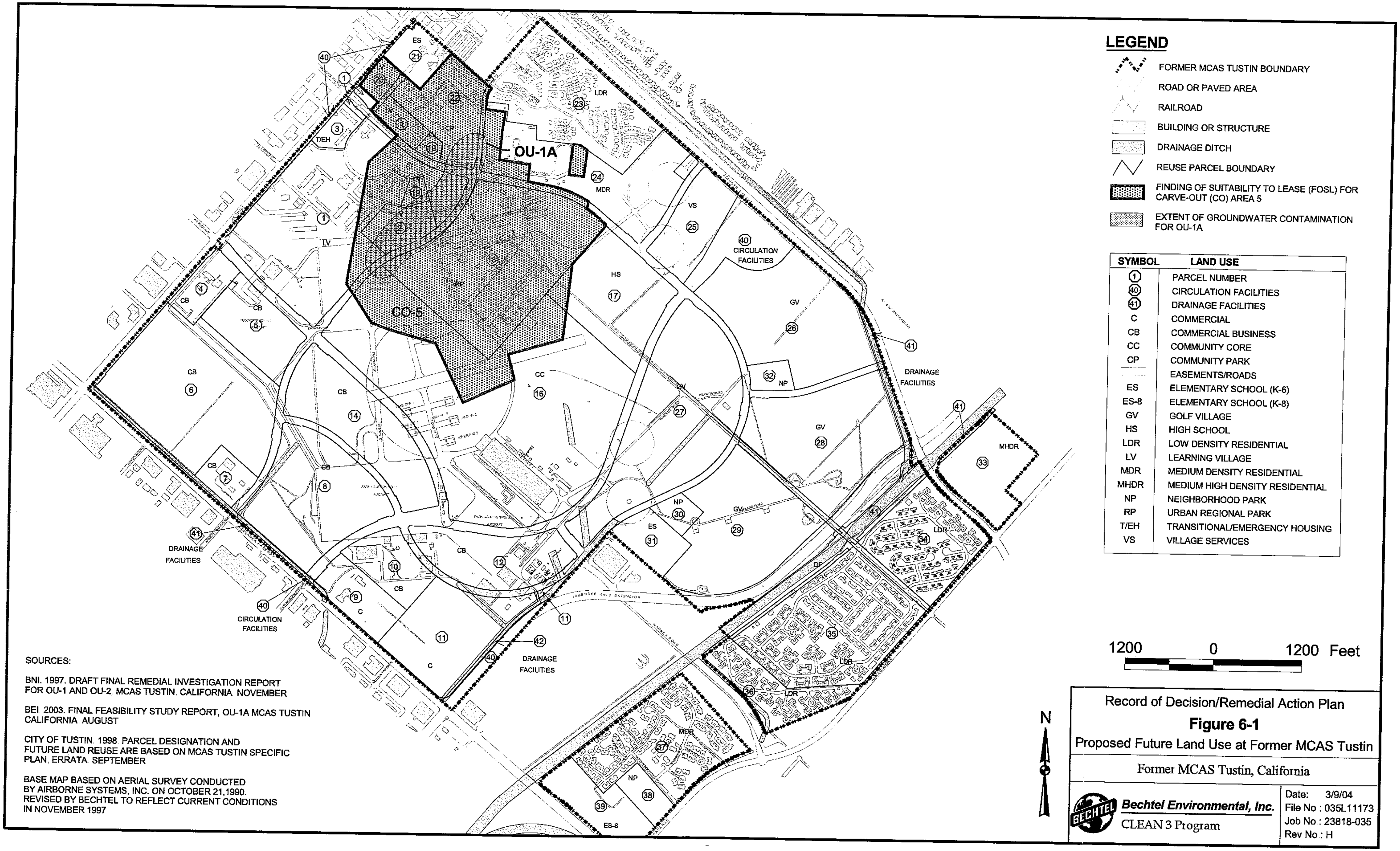
Parcel	Redevelopment Plan
1	Learning Village
2	Community Park
16	Community Core
18,19	Commercial Business
22	Community Park
40	Circulation Facilities

In addition, much of the IRP-13S plume in the first WBZ lies directly under the right-of-way for the planned extension of Armstrong Avenue, Valencia Loop Road, and Severyns Street. A number of below-grade utility improvements are anticipated to be constructed along this corridor, including a sanitary sewer; storm sewer; supply lines for domestic water, gas, and electricity; and telephone, cable television, and other telecommunications infrastructure. The LRA has had discussions with the DON regarding the roadway extension and proposed methods to prevent any negative impacts to the existing plume conditions at OU-1A during construction activities.

On 20 September 1997, HUD conditionally approved the SP as submitted. In addition to HUD concurrence, approval of the document from the Secretary of the Navy was required, along with prior completion of an EIS/EIR designed to evaluate the environmental impacts associated with the closure and reuse of MCAS Tustin. On 31 December 1997, the DON posted in the *Federal Register* formal determination of surplus for the disposal and reuse of MCAS Tustin. The LRA and the USMC finalized a joint EIS/EIR in December 1999 (DON 1999).

6.2 GROUNDWATER USES

Former MCAS Tustin is located within the Irvine groundwater subbasin, which has been designated by RWQCB as a public water supply source (RWQCB 1995). The deep regional aquifer beneath the station is currently a source of municipal drinking water. At present, shallower zones are not used for drinking water because of their generally low



Record of Decision/Remedial Action Plan

Figure 6-1

Proposed Future Land Use at Former MCAS Tustin

Former MCAS Tustin, California

yield and poor quality (i.e., the shallow groundwater is saline to brackish). As noted in Section 5, the highest TDS occurs in the first WBZ. The maximum TDS concentration reported in groundwater from the first WBZ was 23,000 mg/L. Groundwater with TDS concentrations of this magnitude is generally not used for public drinking water (RWQCB 1995).

6.3 SURFACE WATER USES

Several man-made surface water channels at Former MCAS Tustin normally contain water year-round. The channels redirect surface water runoff from Former MCAS Tustin and discharge into San Diego Creek, and ultimately downstream into Newport Bay.

Several sections of the on-site drainage ditches and portions of Peters Canyon Channel and Santa Ana-Santa Fe Channel were designated as potential wetlands by the U.S. Fish and Wildlife Service (USDA 1992). The USACE designated two drainage areas as jurisdictional wetlands (Durham 1996) (Figure 5-3). In 1999, a wetlands determination was completed to verify the extent and quality of wetland habitat and to provide sufficiently detailed and accurate jurisdictional delineations to support permitting and mitigation planning. As a result of this determination, eight areas were identified as jurisdictional waters of the United States. Within those jurisdictional waters, a smaller area was determined to be vegetated wetland/seasonal wetland (BNI 2000b).

No sensitive habitats have been identified at Former MCAS Tustin. However, approximately 5 miles southwest of the station is the upper Newport Bay Ecological Reserve, into which Peters Canyon Channel flows. The reserve was established in 1975 to preserve and enhance this saltwater marsh ecosystem. Eight species classified by California as either rare or endangered are dependent on the upper Newport Bay Ecological Reserve. In addition, a series of marshy wildlife refuges (approximately 300 acres at UCI) is located approximately 5 miles south of the station.

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Section 7
SUMMARY OF SITE RISKS

Baseline risk assessments provide evaluations of the potential threat to human health and the environment in the absence of any remedial action. They form the basis for determining whether remedial action is necessary and the justification for performing remedial actions (U.S. EPA 1988a). A previous risk assessment conducted during the RI evaluated risks to residents under current conditions but did not incorporate risks from affected soils within the OU-1A plume boundaries (BNI 1997b). This risk assessment was revised during the FS to evaluate combined risk from exposure to soil and groundwater, and to evaluate the effect on risk from implementing institutional controls preventing domestic use of groundwater (BEI 2003b). The methodology and the results of the risk assessments are summarized in this section. The risk assessment conducted during the FS included additional construction/utility worker and groundwater-only residential scenarios. A complete discussion of the risk assessment, including the additional scenarios for OU-1A, is presented in Appendix F of the FS Report (BEI 2003b).

Habitat surveys were performed for OU-1A, and it was concluded that no suitable wildlife habitats exist at OU-1A. Therefore, no ecological risk assessment was performed for the site or its associated AOCs.

7.1 BASELINE HUMAN-HEALTH RISK ASSESSMENT

During the FS, an HHRA was performed for the Source Area (IRP-13S) that focused on residential (Source Area) scenarios with beneficial use of groundwater (e.g., drinking, bathing, and other domestic uses) under both current and future conditions (after remedial action objectives are achieved). An additional Source Area residential scenario for nonbeneficial use of groundwater under current conditions was used to evaluate the effect of institutional controls (deed restrictions to prevent extraction and domestic use of contaminated groundwater at the site). Results from the residential HHRA under current conditions assist the DON in determining whether remedial action is necessary for groundwater and soil at the site. Results from the residential HHRA under future conditions estimate risks to residents from residual contamination remaining after the remedial action objectives (RAOs) have been achieved. Calculated risks include the cumulative risk of soil and groundwater contamination at the site. The evaluation of risks to residents under these scenarios is the focus of this ROD/RAP.

7.2 CHEMICALS OF POTENTIAL CONCERN

This section presents an overview of the data evaluation process used to select the COPCs that subsequently were evaluated in the risk assessments for IRP-13S (Table 7-1).

7.2.1 Soil Data and Chemicals of Potential Concern

The risk assessment for IRP-13S was performed IRP-wide and on an individual AOC basis. Selection of COPCs was based on all organic chemicals reported in soil and groundwater samples and on an evaluation of metals reported in soil and groundwater samples compared with background concentrations of metals to identify site-specific chemicals.

Table 7-1
Chemicals of Potential Concern at
Source Areas ST-72B and MWA-18 (Current Conditions)

CAS Number	Chemical	Soil (0–10 feet bgs)*	Groundwater (1st and 2nd WBZ)*
71-55-6	1,1,1-trichloroethane	√	√
79-34-5	1,1,2,2-tetrachloroethane	√	√
76-13-1	1,1,2-trichloro-1,2,2-trifluoroethane	√	√
79-00-5	1,1,2-trichloroethane	√	
75-34-3	1,1-dichloroethane		√
75-35-4	1,1-dichloroethene	√	√
87-61-6	1,2,3-trichlorobenzene		√
96-18-4	1,2,3-trichloropropane	√	√
354-23-4	1,2-dichloro-1,1,2-trifluoroethane		√
95-50-1	1,2-dichlorobenzene		√
78-87-5	1,2-dichloropropane		√
541-73-1	1,3-dichlorobenzene		√
142-28-9	1,3-dichloropropane		√
106-46-7	1,4-dichlorobenzene		√
78-93-3	2-butanone	√	√
591-78-6	2-hexanone	√	√
108-10-1	4-methyl-2-pentanone		√
67-64-1	acetone	√	√
7440-36-0	antimony		√
319-84-6	alpha-BHC	√	
71-43-2	benzene	√	
7440-43-9	cadmium		√
75-15-0	carbon disulfide		√
108-90-7	chlorobenzene		√
67-66-3	chloroform	√	√
156-59-2	cis-1,2-dichloroethene	√	√
75-71-8	dichlorodifluoromethane		√
79-38-9	ethene, chlorotrifluoro-		√
100-41-4	ethylbenzene		√
7439-92-1	lead		√
7816-60-0	m- and p-xylenes	√	√
7439-96-5	manganese	√	

(table continues)

Table 7-1 (continued)

CAS Number	Chemical	Soil (0–10 feet bgs)*	Groundwater (1st and 2nd WBZ)*
7439-97-6	mercury	√	
75-09-2	methylene chloride	√	√
91-20-3	naphthalene		√
7440-02-0	nickel		√
95-47-6	o-xylene	√	√
7782-49-2	selenium		√
127-18-4	tetrachloroethene	√	√
108-88-3	toluene	√	√
156-60-5	trans-1,2-dichloroethene	√	
79-01-6	trichloroethylene	√	√
75-69-4	trichlorofluoromethane		√
7440-62-2	vanadium		√
7440-66-6	zinc		√

Note:
* volatile organic compound (VOC) concentrations from this data set were used for air modeling

Acronyms/Abbreviations:
bgs – below ground surface
BHC – benzene hexachloride
CAS – Chemical Abstracts Service
WBZ – water-bearing zone

Analytical data used to evaluate risks were obtained from soil samples collected during the RI (BNI 1997b) and during RCRA AOC investigations (OHM 2001b,c,d). Analytical results from soil collected prior to being excavated during subsequent removal actions were excluded from the above-mentioned data sets.

The identification of COPCs for soil was based on data collected at depths from 0 to 10 feet bgs. It should be noted that the water table is reported at approximately 10 feet bgs. Therefore, the data set for COPCs at OU-1A consists of all chemicals identified in the vadose zone. Concentrations of metals reported in soil samples were compared to background concentrations to identify site-related chemicals as COPCs.

Reported concentrations of metals in soil samples were compared with background concentrations to identify possible site-related analytes as COPCs. Maximum reported concentrations of metals in on-site soil were compared to the 99th percentile of the background data. If the maximum reported concentration of a metal was less than the background concentration, then the metal was eliminated from consideration as a COPC. Background concentrations of metals in soil at Former MCAS Tustin were established on the basis of statistical results obtained from approximately 650 to 900 soil samples

(BNI 1996d). Inorganic nutrients (calcium, magnesium, potassium, and sodium), which are known to be required human trace elements, were excluded as COPCs.

7.2.2 Groundwater Data and Chemicals of Potential Concern

Selection of COPCs for groundwater at IRP-13S (Table 7-1) was based primarily on data from groundwater samples collected from monitoring wells installed in the first and second WBZs during the RI (BNI 1997b) and subsequent groundwater monitoring events (BEI 2003a). The data sets, composed of analytical results collected from 1996 to 2002, are summarized in Part III of the Appendix F of the FS Report (BEI 2003b).

Groundwater samples collected from HydroPunch borings were also used in the selection of COPCs. HydroPunch groundwater samples generally are more turbid than samples collected from monitoring wells, which are constructed with filter pack and screen and are developed to reduce turbidity. Metals were excluded from the HydroPunch data set on the basis of the high turbidity associated with suspended material in these samples. All results for metals from unfiltered groundwater samples collected from monitoring wells were included in the groundwater data set. All organic chemicals from both sample types were classified as COPCs.

Concentrations of metals in groundwater were statistically compared to their respective background concentrations to identify which analytes would be considered site-related COPCs. In particular, the RI (BNI 1997b) and FS (BEI 2003b) evaluated concentrations of arsenic in groundwater at OU-1A and demonstrated that they did not vary significantly in samples collected from the first, second, or third WBZ, or in samples collected from other areas within the regional aquifer. On this basis, arsenic was eliminated as a COPC at OU-1A.

7.3 EXPOSURE ASSESSMENT

Human-health risk at IRP-13S was evaluated for current and future conditions with beneficial use of groundwater and for current conditions with nonbeneficial use of groundwater under a residential scenario. Groundwater in the shallow aquifer at Former MCAS Tustin is not currently used for domestic purposes, and it is unlikely that this groundwater would be used for such purposes in the future due to its naturally occurring high concentrations of nitrates and TDS. Nonetheless, cumulative soil and groundwater exposure under a residential scenario for current and future conditions has been evaluated with hypothetical residential receptors (resident adult and child) exposed to COPCs in soil through the following exposure pathways:

- ingestion of impacted soil
- dermal contact with impacted soil
- inhalation of particulates that have been released from impacted soil
- inhalation of chemical vapors released from soil that accumulates in buildings

Potential exposure to COPCs in groundwater under a beneficial groundwater-use scenario is based on the following exposure pathways:

- inhalation of chemical vapors released from groundwater during household water use that accumulate in buildings
- ingestion of groundwater
- dermal contact with groundwater

The risk under the residential scenario with nonbeneficial use of groundwater is evaluated on exposure to indoor vapors as VOCs are released from the groundwater into the overlying soil, further penetrating the building through the cracks in the foundation. Dermal contact and ingestion of groundwater are pathways not addressed under the nonbeneficial use scenario because residents are not considered to be in direct contact with groundwater. An evaluation was conducted to determine whether institutional controls and/or restrictions would be protective of human health for indoor occupancy of existing and/or newly constructed buildings using these risk results.

Dust and vapors are assumed to have originated exclusively from the area being evaluated. Chemical vapors released to the atmosphere could potentially accumulate inside a building or structure as a result of the confined space and limited ventilation. Therefore, in the interest of public protection, exposure to soil and groundwater vapors at IRP-13S for residential receptors was assumed to occur exclusively indoors.

U.S. EPA guidance states that potential remedial actions should be based on an estimate of the reasonable maximum exposure (RME) expected to occur under both current and future land-use conditions. The RME is defined as the "highest exposure that is reasonably expected to occur at a site" (U.S. EPA 1989). The intent of the RME is to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possibilities.

To achieve this conservative exposure case approach, the exposure point concentration (EPC) was assumed to be either the 95 percent upper confidence limit (UCL) of the average reported concentration of a chemical or the maximum reported concentration. Maximum reported concentrations were used instead of the 95 percent UCL when the 95 percent UCL of a chemical exceeded its highest reported concentration or when a low number of samples or a low frequency of detection rendered the use of the statistically derived 95 percent UCL inapplicable. It was also assumed that soil and groundwater contaminant concentrations remained constant for the duration of the exposure period.

7.3.1 Exposure Point Concentrations for COPCs in Soil – Current Conditions

Exposure to soil COPCs is related to depth; therefore, the assessment is limited to chemicals found within the depth of concern. The data sets used to estimate risks to a hypothetical resident from exposure to COPCs at IRP-13S were based on the reported concentrations in shallow soil at depths ranging from 0 foot bgs to the water table (approximately 10 feet bgs).

7.3.2 Exposure Point Concentrations for COPCs in Groundwater – Current Conditions

Data for shallow groundwater from the first and second WBZs at IRP-13S were used in the selection of COPCs in the baseline HHRA under residential scenarios. The groundwater EPCs used from these data sets are either 95 percent UCLs or maximum reported values.

7.3.3 Exposure Point Concentrations for COPCs in Air – Current Conditions

EPCs were calculated for potential sources of airborne chemicals, which were considered to be 1) contaminated soil from which chemical vapors and particles could be released and 2) contaminated groundwater from which chemical vapors could be released. Particulate concentrations used in the risk assessment were based on data recorded for the South Coast Basin from 1988 to 1996. Vapor concentrations were estimated using the Johnson and Ettinger air model (U.S. EPA 1998). Details of the Johnson and Ettinger air modeling input and output parameters are provided in Appendix F of the FS Report (BEI 2003b).

7.3.4 Exposure Point Concentrations for Future Conditions

Risks to hypothetical resident receptors in the Source Area were evaluated under future conditions from exposure to soil and groundwater after completion of remedial action. The assessment of future risk is addressed for only the residential scenario with beneficial groundwater use.

7.3.4.1 EXPOSURE POINT CONCENTRATIONS FOR COPCs IN GROUNDWATER

To represent future EPCs for VOCs (with the exception of 1,2,3-TCP), present-day concentrations are multiplied by a factor that reflects the overall concentration decline within the plumes after 30 years, based on groundwater modeling results completed for Alternative 7, hydraulic containment with hot spot removal. The simulated reduction in concentrations of TCE was used as an indicator for all groundwater VOCs (with the exception of 1,2,3-TCP). Although groundwater modeling results indicate that future concentrations of TCE would approach zero, the current approximate laboratory reporting limit, 0.5 µg/L, was selected as the future (conservative) EPC for TCE. The future EPC for TCE resulted in an estimated 80 percent reduction, which was used as an indicator for all groundwater VOCs. The future EPC for 1,2,3-TCP was the resultant simulated concentration given by the groundwater modeling results (approximately 1 µg/L) for Alternative 7 after 30 years, an approximately 92 percent reduction from current conditions.

TCE is considered to be a conservative cleanup indicator relative to other VOC risk drivers because it has a lower aqueous solubility and a greater tendency to adsorb to soil than other VOCs. These factors would tend to lengthen the time required to reduce TCE groundwater concentrations compared to compounds that have a higher solubility and less tendency to adsorb to soil. Because groundwater cleanup was intended for VOCs, the assessment of risk for other analytes (e.g., semivolatile organic compounds, pesticides, and metals) under future conditions assumes a steady-state approach. Therefore, their current-day EPCs are used without concentration declines after implementation of the selected remedy.

7.3.4.2 EXPOSURE POINT CONCENTRATIONS FOR COPCs IN SOIL

Data from soil excavated as part of removal actions have been eliminated from the data set for soil under future conditions. Hot spot soil removal was projected only for the Source Area.

7.3.5 Exposure Assumptions

Exposure assumptions describe the rate of contact that the receptors could have with the soil, water, or air. U.S. EPA guidelines on upper-bound exposure assumptions are designed to address conservatively the behavior or activity patterns of more than 90 to 95 percent of the receptor populations. The intent is to estimate an RME.

The exposure assumptions for a hypothetical resident adult and child exposed to COPCs at OU-1A are the following standard U.S. EPA default assumptions.

- For soil oral exposure, 100 milligrams a day was assumed for a 70-kilogram adult and 200 milligrams a day for a 15-kilogram child (age 1 to 6 years), 350 days a year.
- For soil dermal exposure, over 30 percent of the resident's skin is in contact with soil for 350 days a year.
- Inhalation of dust and vapors was assumed to occur 24 hours a day, 350 days a year.
- Exposure to vapors was assumed to occur exclusively indoors.
- For groundwater consumption, 2 liters of water a day was assumed for a 70-kilogram adult and 1 liter a day for a 15-kilogram child (age 1 to 6 years), 350 days a year.
- For groundwater dermal exposure during showering, whole-body exposure (7,000 square centimeters for children and 19,000 square centimeters for adults) was assumed to occur for 0.25 hour a day, 350 days a year.
- Adult exposure to carcinogens was assumed for a total of 30 years, 6 years as a child and 24 years as an adult (child exposure was assumed to be 6 years).

7.4 TOXICITY ASSESSMENT

The toxicity assessment categorized the COPCs by their carcinogenic and noncarcinogenic effects. The potential for carcinogenic effects was evaluated by estimating excess lifetime cancer risk. Noncarcinogenic risk was assessed by comparing the estimated daily intake of a chemical to the estimated safe level of daily exposure (reference dose [RfD]). The toxicity values used in the risk assessment were obtained from the 2002 table of preliminary remediation goals published by U.S. EPA Region 9 (U.S. EPA 2002a) and were confirmed by a review of the U.S. EPA Integrated Risk Information System database (U.S. EPA 2002b) and the U.S. EPA Health Effects Assessment Summary Tables (U.S. EPA 1997a).

Slope factors are not available for the dermal route of exposure. Thus, the dermal slope factors used in the risk assessment were extrapolated from oral values.

7.5 RISK CHARACTERIZATION

Cancer and noncancer risks were quantified separately. Excess lifetime cancer risks are presented as probabilities generally expressed in scientific notation (e.g., 1×10^{-6} or 1E-6). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a 1 in 1 million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site. Guidelines for managing cancer risks are promulgated in the NCP (Title 40 *Code of Federal Regulations* [C.F.R.] 300.430[e][2][I][A][2]). According to these regulations, an excess cancer risk of 1×10^{-6} is allowable, and excess cancer risks ranging from 1×10^{-6} to 1×10^{-4} are considered generally allowable. Cancer risks greater than 1×10^{-4} require further evaluation and may indicate a need for remedial action.

Noncarcinogenic effects from a single contaminant in a single medium are expressed as a hazard quotient (HQ). The sum of the HQs for all contaminants within a medium or across all media is expressed as the hazard index (HI). An HI less than 1.0 is generally considered to represent an allowable noncarcinogenic risk. An HI equal to or greater than 1.0 indicates that a lifetime of exposure to the chemical(s) may have the potential for causing adverse health effects (e.g., respiratory distress, kidney failure) and should be evaluated further.

Results for human-health risks evaluated for current and future conditions at IRP-13S are summarized in Table 7-2. Estimates for cancer risks using both U.S. EPA and California Environmental Protection Agency (Cal/EPA) cancer slope factors (CSFs) are presented in the table.

Three residential scenarios were conducted for the Source Area: one under current conditions (with beneficial use of groundwater), one under future conditions (with beneficial use of groundwater), and one under current conditions (with nonbeneficial use of groundwater).

Table 7-2
Total Cancer and Noncancer Risk Estimates
for Source Area Residential Scenarios

Exposure Route	Cancer Risk U.S. EPA[a b]	Cancer Risk State[c,d,e]	Hazard Index[d,e]
Resident with beneficial use of groundwater:			
Source Area (current conditions)			
Soil total[f]	9.3E-06	7.1E-07	1.0
Groundwater total[g] (indoor vapor inhalation)	4.7E-03	4.6E-03	6.3
Total	**4.8E-03**	**4.6E-03**	**7.3**
Resident with beneficial use of groundwater:			
Source Area (future conditions)			
Soil total[f]	5.0E-06	1.0E-07	1.0E-09
Groundwater total[g] (indoor vapor inhalation)	4.0E-04	3.9E-04	2.6
Total	**4.0E-04**	**3.9E-04**	**3.7**
Resident with nonbeneficial use of groundwater:			
Source Area (current conditions)			
Soil total[f]	9.3E-06	7.1E-07	1.0
Groundwater total[g] (indoor vapor intrusion)	1.1E-06	1.7E-06	0.00093
Total	**1.0E-05**	2.4E-06	**1.0**

Notes:
- [a] risk was calculated using U.S. EPA toxicity values
- [b] the risk is higher for the resident adult; therefore, only the resident adult risk results are shown
- [c] risk was calculated using Cal/EPA toxicity values except for 1,2,3-TCP; U.S. EPA toxicity value for 1,2,3-TCP was used in calculation of Cal/EPA cancer risk estimates since Cal/EPA does not have a toxicity value for 1,2,3-TCP
- [d] the index is higher for the resident child; therefore, only the resident child index is shown
- [e] based on use of child reference doses
- [f] soil areas evaluated in the risk assessment include source areas ST-72B and MWA-18
- [g] household water use – indoor vapor inhalation for groundwater refers to released groundwater vapors that accumulate in buildings during all uses of household water

Acronyms/Abbreviations:
- Cal/EPA – California Environmental Protection Agency
- IRP – Installation Restoration Program
- NA – not assessed
- TCP – trichloropropane
- U.S. EPA – United States Environmental Protection Agency

7.5.1 Residential Risk Under Current Conditions With Beneficial Use

Total cancer and noncancer risk estimates (using U.S. EPA criteria) for the Source Area exceed the upper limit of the generally allowable risk range for cancer risk established by U.S. EPA (10^{-6} to 10^{-4}) and the noncancer threshold value (or HI) of 1.0 (which indicates the potential for development of adverse health effects) (Table 7-2). Total cancer risks at the Source Area are estimated to be 4.8×10^{-3} and are primarily associated with exposure to 1,2,3-TCP in groundwater using U.S. EPA risk factors Results from the risk assessment indicate the calculated risk estimates within the Source Area using U.S. EPA and Cal/EPA slope factors are comparable. Therefore, risk estimates using U.S. EPA slope factors will be used for discussion purposes for this section. Noncancer risk (or HI) calculated for a resident child at the Source Area is estimated to be 7.3 and is principally related to 1,2,3-TCP and selenium in groundwater.

Selenium was not identified as a site-related chemical at OU-1A. Furthermore, the background threshold concentration for selenium in the first WBZ at Former MCAS Tustin is 0.33 mg/L, while the EPC for selenium in groundwater at OU-1A is 0.15 mg/L. This indicates that selenium concentrations in groundwater at OU-1A do not exceed background concentrations and, therefore, the risks are related to selenium as a naturally occurring chemical in groundwater at the site.

7.5.2 Residential Risk Under Future Conditions With Beneficial Use

The total future cancer risk estimated under the residential scenario at the Source Area is 4.0×10^{-4}, which exceeds the NCP's generally allowable risk range of 10^{-6} to 10^{-4} (Table 7-2). The principal cancer risk driver is 1,2,3-TCP in groundwater. This risk value represents an approximately 92 percent reduction in the U.S. EPA-derived risk estimate at current conditions. The noncancer threshold value (HI) for a resident child under future conditions at the Source Area is estimated to be 3.7 and is associated with selenium in groundwater and manganese in soil. This represents an approximately 49 percent reduction in noncancer risk at current conditions. The reduction in cancer and noncancer risk is principally related to the removal of 1,2,3-TCP in groundwater.

It should be noted that current and future risk assessment results presented herein were based on groundwater modeling using conservative assumptions and were prepared for very conservative residential scenarios in which the domestic use of groundwater (e.g., drinking, bathing, and other domestic uses) was assumed to occur over a period of 30 years. Domestic use of groundwater from the shallow aquifer is unlikely due to the poor quality of the water (e.g., elevated concentrations of TDS, nitrates, and salinity). The actual risks posed to residents under future conditions are expected to be less, and will be lowered based on the effectiveness of institutional controls in preventing the exposure to and domestic use of shallow groundwater; the effectiveness of the proposed containment and treatment system in reducing the mass, extent, and concentrations of VOCs in shallow groundwater; and on other factors such as the extent and effectiveness of natural attenuation. (Note: As a conservative assumption, groundwater modeling assumed no natural attenuation.)

7.5.3 Residential Risk Under Current Conditions With Nonbeneficial Use

An additional, more realistic residential scenario was used to estimate risks to human health assuming nonbeneficial use of groundwater (i.e., institutional controls in place that prevent groundwater use). Information from this scenario may be used to determine whether institutional controls and/or restrictions would be protective of human health for indoor occupancy of existing and/or newly constructed buildings at the site. This scenario uses all reported VOCs with EPCs calculated at a 95 percent UCL of the mean value of their respective reported concentrations.

Total cancer and noncancer risk estimates (using U.S. EPA criteria) for the Source Area fall within the generally allowable risk range for cancer risk established by U.S. EPA (10^{-6} to 10^{-4}) and do not exceed the noncancer threshold value (HI) of 1.0 (Table 7-2). Total cancer risk at the Source Area is estimated to be 1.0×10^{-5} and is primarily associated with exposure to TCE and 1,2,3-TCP in soil vapor. Noncancer risk (HI) calculated for a resident child at the Source Area is estimated to be 1.0. These results indicate that with institutional controls in place to prevent domestic use of groundwater, cancer risk is reduced by more than two orders of magnitude to fall within the generally allowable risk range established by U.S. EPA (10^{-6} to 10^{-4}).

7.6 RECOMMENDATIONS AND BASIS FOR RISK MANAGEMENT DECISION

On the basis of results of the baseline HHRA, the DON and BCT have determined that remedial action is required to reduce concentrations of contaminants in groundwater at OU-1A. Remedial action is not required to reduce risks from soil, since risks due to soil contamination are considered generally allowable per the NCP criteria. However, soil with elevated concentrations of VOCs is recommended for removal to prevent further contamination of groundwater. The rationale for this decision is discussed in the following paragraphs.

Cancer risk estimates are primarily associated with exposures to groundwater. Inhalation of groundwater vapors during household water use was the dominant risk pathway. Over 95 percent of the U.S. EPA cancer risk is attributable to the concentrations of 1,2,3-TCP in groundwater. Chemicals reported in soil contribute less than 1 percent of the total residential cancer risk.

Estimates of risk under a residential scenario with nonbeneficial use of groundwater (i.e., institutional controls to prevent groundwater use) at current conditions would fall within U.S. EPA's generally allowable risk range (10^{-4} to 10^{-6}). Therefore, institutional controls would be effective in protecting human health and allow for the reuse of existing and newly constructed buildings within the site boundary for OU-1A.

The main exposure pathway under this scenario is indoor vapor inhalation of TCE in groundwater (63 percent), since exposure to 1,2,3-TCP from groundwater use is prevented through institutional controls.

The HI for a hypothetical resident child exposed to soil and groundwater under present-day and future conditions exceeds the systemic toxicity threshold of 1.0, indicating a potential for the development of adverse health effects. At present the HI, which is estimated at 7.3, is primarily associated with groundwater exposures to 1,2,3-TCP (38 percent) and selenium (26 percent) (Table 7-2). Exposure to soil COPCs resulted in an HI estimated at 1.0 (14 percent).

The HI for soil at the Source Area is primarily attributable to manganese. This exceedance is considered allowable for the following reasons.

- Manganese is a naturally occurring metal, and there was neither documentation nor historical information indicating that manganese had been used in operations at IRP-13S.
- Because manganese is typically added to steel alloys to improve strength and other forging qualities, it is highly unlikely to leach or otherwise be released into soil.
- The inhalation RfD used to evaluate risk due to manganese is estimated only for an adult receptor. Use of an adult RfD overestimates the resultant hazard to a child.

Section 8
DESCRIPTION OF ALTERNATIVES

This section describes the remedial alternatives selected for detailed analysis in the OU-1A FS Report. The alternatives are based on the RI, baseline HHRA, and a review of applicable or relevant and appropriate requirements (ARARs). The following overall RAOs were developed for OU-1A to focus the FS Report and define the scope of potential groundwater remediation activities

- Reduce the concentrations of VOCs in groundwater to levels consistent with remediation goals, or until the plumes have stabilized, and prevent or limit VOC migration beyond the current OU-1A plume boundaries.
- Protect human health by preventing extraction of VOC-impacted shallow groundwater for domestic use until remediation goals are achieved.
- Protect potential ecological receptors in Barranca Channel by preventing the off-station migration of groundwater containing VOCs at concentrations exceeding remediation goals.
- Implement appropriate remedial actions as necessary to facilitate transfer and reuse of those portions of the Former MCAS Tustin property actually or potentially affected by the OU-1A plumes.

While VOC-affected soil is of concern as a continuing source of groundwater contamination, the risk assessment completed for the RI showed that the risk due to soil at IRP-13S is acceptable for human health even if future land use at the station includes redevelopment as residential areas and/or parks (BNI 1997b). These are the most sensitive uses for the Former MCAS Tustin property projected in the SP. Therefore, remediation of contaminated soils to health-based criteria was not an RAO of the FS, but was included to further enhance contaminant mass removal, lessen the time needed to achieve remediation goals or stabilize the plumes, and remove a potential continuing source of VOCs to groundwater resulting in concentrations exceeding the MCL.

8.1 CHEMICALS OF CONCERN AND REMEDIATION GOALS

Table 8-1 lists the groundwater chemicals of concern (COCs) at OU-1A: TCE and 1,2,3-TCP. For each of these VOCs, Table 8-1 presents the reporting frequency and concentration range for groundwater samples collected during the RI (BNI 1997b). In identifying these chemicals as COCs, it was assumed that chlorinated VOCs do not occur as natural constituents in groundwater at Former MCAS Tustin, and therefore background concentrations (i.e., zero) of chlorinated VOCs in groundwater at OU-1A were below the detection limits of available U.S. EPA analytical methods.

Table 8-2 lists numerical remediation goals for OU-1A groundwater that were developed in the FS based on an analysis of ARARs (BEI 2003b). The remediation goal for TCE (5 μg/L) listed in Table 8-2 is based on the federal MCL promulgated by U.S. EPA and is equal to the California MCL established by the Department of Health Services. The remediation goal for 1,2,3-TCP (0.5 μg/L) is a risk-based goal developed in Section 2.5

Table 8-1
Chemicals of Concern in OU-1A Groundwater

Chemical	Reporting Frequency[a]	Concentration Range[b] (μg/L)
trichloroethene (TCE)	56/120	1.3–310
1,2,3-trichloropropane (1,2,3-TCP)	62/120	1.7–340

Notes:
[a] number of samples in which the contaminant was reported as detected/total number of groundwater samples collected during the RI (BNI 1997b)
[b] range of concentrations for samples with reportable levels of the contaminant

Acronyms/Abbreviations:
μg/L – micrograms per liter
OU – operable unit
RI – remedial investigation

Table 8-2
Remediation Goals for OU-1A Groundwater

Chemical	Remediation Goal (μg/L)	Basis
trichloroethene (TCE)	5	Federal MCL*
1,2,3-trichloropropane (1,2,3-TCP)	0.5	Risk based

Note:
* 40 C.F.R. § 141.61

Acronyms/Abbreviations:
C.F.R. – *Code of Federal Regulations*
μg/L – micrograms per liter
MCL – maximum contaminant level
OU – operable unit
§ – section

of the OU-1A FS Report (BEI 2003b), after consideration of the best available toxicological information on the drinking water health risks posed by 1,2,3-TCP and of the limitations of current analytical methodology. The current laboratory reporting limit for 1,2,3-TCP in groundwater is 0.5 µg/L and is less than the 1 µg/L limit that was determined to be achievable for groundwater at OU-1A using best available technologies (BEI 2003b). These groundwater remediation goals were developed as the concentrations necessary to achieve the first RAO for OU-1A. The RAO can also be achieved by demonstrating that the plumes have stabilized and will not migrate beyond the current OU-1A boundaries. Permanent shutdown of the hydraulic containment system is subject to DTSC, RWQCB, and U.S. EPA approval.

The feasibility of cleaning up groundwater to background concentrations was evaluated in the OU-1A FS Report (BEI 2003b). The FS Report noted that past U.S. EPA efforts to restore VOC-affected aquifers to background levels using groundwater extraction have generally not been successful (U.S. EPA 1996a). When extraction systems are installed, experience at full-scale remediation sites has often shown that contaminant concentrations in the groundwater decline rapidly during the initial period of operation. However, a potentially significant fraction of the contaminant mass remains adsorbed to or otherwise entrained within the aquifer matrix, including the upper confining layer in the first WBZ. The essentially immobile material remains an active, albeit low-level, contaminant source that is slowly released to groundwater via diffusion, desorption, or dissolution over an extended period of time. This leads to a leveling-off of contaminant concentrations, in many cases above remediation goals, and makes removal of contamination to background levels virtually impossible.

Similarly at Former MCAS Tustin, TCE concentrations in extracted groundwater would be expected to decline rapidly during the first several years of remediation and then be maintained at an asymptotic level for a long period of time. Removal of all traces of TCE and 1,2,3-TCP (or other VOC compounds) would require permanent operation of the extraction system, resulting in significant (unreasonable) long-term costs with negligible benefit. Because attaining background levels (i.e., VOC concentrations at zero) is not considered technologically feasible, restoration of the shallow aquifer at Former MCAS Tustin to pristine conditions was not included as an RAO, nor was background considered a potential remediation goal for VOCs in OU-1A groundwater. Other concentration limits determined to be protective of human health and the environment (i.e., MCLs), as provided in *California Code of Regulations* (Cal. Code Regs.) title (tit.) 22, § 66264.94(c), will be used to satisfy RCRA groundwater protection requirements.

Table 5-1 lists the areal dimensions, maximum reported concentrations, and total estimated mass of TCE and 1,2,3-TCP at the first and second WBZs. These estimates were developed from data in the RI Report (BNI 1997b) and the results of groundwater modeling presented in Appendix B of the FS Report (BEI 2003b).

8.2 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Remedial alternatives were developed to meet the RAOs in accordance with CERCLA, as amended by SARA, 42 *United States Code* (U.S.C.) § 9602 et seq., and the NCP. The development of remedial alternatives was also guided by prior U.S. EPA experience at VOC-contaminated sites. Documents considered in the development of remedial alternatives for soil and groundwater include the following.

- **Contaminants and Remedial Options at Solvent-Contaminated Sites** (U.S. EPA 1994a) identifies response actions and remedial technologies commonly used and demonstrated to be effective for remediation of soils and groundwater with contaminants similar to those at IRP-13S.
- **Remediation Technologies Screening Matrix and Reference Guide** (U.S. EPA 1994b) provides a comprehensive listing of remedial technologies for VOC-contaminated soil and groundwater. This U.S. EPA reference effectively serves as a preliminary screening step to determine the technical implementability of various technologies for possible use at OU-1A.
- **Presumptive Response Strategy and *Ex Situ* Treatment Technologies for Contaminated Groundwater at CERCLA Sites** (U.S. EPA 1996b) states that groundwater extraction, source removal, and natural attenuation, alone or in combination, constitute the presumptive remedy for contaminated groundwater at sites where DNAPLs are not a concern. The presumptive technologies listed for *ex situ* treatment of VOCs in extracted groundwater include air stripping, GAC adsorption, chemical oxidation, and aerobic biological treatment.
- **Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites With VOCs in Soils** (U.S. EPA 1993, 1996a) identifies soil vapor extraction (SVE), thermal desorption, and incineration as presumptive remedies for VOCs in soils.
- **Presumptive Remedy: Supplemental Bulletin Multiphase Extraction (MPE) Technology for VOCs in Soil and Groundwater** (U.S. EPA 1997b) defines vacuum-enhanced extraction (VEE) (also known as MPE) as another presumptive technology for remediation of VOCs in soil and groundwater. MPE combines key components of conventional groundwater extraction and SVE. It is described by U.S. EPA as particularly applicable to sites such as Former MCAS Tustin with significant concentrations of VOCs adsorbed to low-permeability soils below the water table.

Presumptive remedies are preferred technologies for common categories of sites. These technologies are accepted by U.S. EPA based on historical patterns of remedial action selection and on evaluation of performance data on technology implementation; use of these technologies expedites site investigation and selection of remediation alternatives.

The use of the U.S. EPA presumptive remedy guidance resulted in development of the following nine comprehensive remedial alternatives:

- Alternative 1 – no action
- Alternative 2 – monitored natural attenuation
- Alternative 3 – hydraulic containment
- Alternative 4 – aggressive groundwater extraction with off-site soil disposal
- Alternative 4A – aggressive groundwater extraction with on-site soil treatment
- Alternative 5 – permeable reaction wall
- Alternative 6 – vacuum-enhanced extraction with off-site soil disposal
- Alternative 6A – vacuum-enhanced extraction with on-site soil treatment
- Alternative 7 – hydraulic containment with hot spot removal

Alternatives 4A and 6A are variations of Alternatives 4 and 6, respectively, that were developed to provide an option of on-site soil treatment and reuse rather than off-site soil disposal at a landfill.

Numerical remediation goals discussed in Section 8.1 and listed in Table 8-2 were used in the FS to compare the effectiveness of the remedial alternatives in decreasing contaminant concentrations to achieve the RAOs. However, achieving numerical remediation goals or demonstrating plume stability within its current boundaries can be used as a criterion for success in achieving the first RAO for OU-1A.

8.2.1 Alternative 1 – No Action

Alternative 1 is required by CERCLA to provide a basis for developing and evaluating the other remedial alternatives. Under Alternative 1, no remedial measures or land-use controls would be implemented. Without remedial action, the impacted area on the Former MCAS Tustin property would expand significantly over time. VOC-contaminated groundwater would be expected to begin impacting Barranca Channel in approximately 40 years. Modeling of groundwater flow and contaminant transport presented in the RI (BNI 1997b) predicted that under the no action alternative, the 1,2,3-TCP and TCE plumes in the sand layer of the first WBZ would migrate approximately 2,900 and 2,000 feet, respectively, farther downgradient over the next 30 years. In the sand layer of the second WBZ, the 1,2,3-TCP plume is predicted to migrate approximately 3,200 feet farther downgradient in 30 years.

Groundwater modeling results indicate that with no active remediation, the VOC plumes in both the first and the second WBZs would move downgradient in the direction of the Barranca Channel and eventually discharge to surface water. 1,2,3-TCP reported at concentrations exceeding the detection limit in groundwater in the first WBZ would begin to impact Barranca Channel in approximately 50 years, reaching an estimated maximum concentration of 4 μg/L in 90 years. VOCs in groundwater in the second WBZ would initially reach Barranca Channel in approximately 40 years, reaching an estimated maximum concentration of 13 µg/L in approximately 70 years. Eventually, the VOC concentration would decrease to groundwater remediation goals because of natural attenuation in the aquifer. However, without any remedial action, the time required to meet these goals is expected to be more than 100 years.

8.2.2 Alternative 2 – Monitored Natural Attenuation

Monitored natural attenuation (Alternative 2) would not entail engineered response actions to collect, treat, or contain the contaminant plumes at and downgradient from IRP-13S. However, Alternative 2 would include monitoring and institutional controls. Monitoring would be used to track VOC migration and support future evaluations of the protectiveness of natural attenuation processes.

Alternative 2 is based on the following assumptions.

- Naturally occurring processes in the subsurface at Former MCAS Tustin will reduce contaminant concentrations—and risk—as the OU-1A plumes continue to migrate through the shallow aquifer.
- Contaminant migration in the subsurface is primarily horizontal, toward Barranca Channel. VOC contamination in the shallow aquifer does not threaten most of the deeper regional aquifer used for potable water supply. The exception to this migration is a localized area approximately 1,500 feet downgradient from IRP-13S. At that location, a lithologic discontinuity appears to have permitted vertical hydraulic communication and downward migration of 1,2,3-TCP into the third WBZ, which is the apparent transition zone between the shallow aquifer and the underlying regional aquifer at Former MCAS Tustin.
- Contaminant migration in the shallow aquifer can be readily tracked, and its impacts are reliably predicted.

The natural attenuation mechanisms that appear active at IRP-13S include adsorption, dispersion, volatilization, diffusion, and dilution. Biodegradation is probably negligible given the recalcitrant nature of chlorinated VOCs under the prevailing aerobic conditions in the shallow aquifer underlying Former MCAS Tustin. Groundwater modeling predicted that the maximum TCE and 1,2,3-TCP concentrations in the sand layers of the first and second WBZs would decrease from existing levels by factors ranging from 60 to 75 percent over 30 years. However, in no case would the maximum VOC concentrations in the sand layers be less than the remediation goals of 5 µg/L TCE (federal MCL) and 0.5 µg/L 1,2,3-TCP. Because no federal and/or state MCLs have been established for 1,2,3-TCP, the DON developed a remediation goal based on an evaluation of the risk for 1,2,3-TCP.

There is no evidence that natural biodegradation processes are removing significant quantities of chlorinated VOCs in groundwater at the site, although such reactions could also occur at a slow rate in localized areas and would act to retard plume migration.

The time estimated for remediation, based on groundwater modeling, is greater than 100 years.

Alternative 2 would include long-term monitoring and periodic reviews to assess potential impacts to human health and/or the environment arising from the continued migration of VOC contamination in the shallow aquifer. VOC contamination originating at IRP-13S is not expected to reach the station boundaries for approximately 40 years. Institutional controls would be used to prevent human exposure to this contamination as it migrates beneath the station. Monitoring would track the progress of natural attenuation and help verify model predictions. Periodic reviews would be scheduled at least every 5 years. These evaluations would consider whether the modeling predictions were accurate and also whether the contaminant levels expected at the station boundaries would impact off-station human and environmental receptors.

Potential off-station impacts resulting from Alternative 2 would be determined by the types of land use in the areas affected by the VOC plumes. The VOC plumes originating at IRP-13S would migrate beneath a future industrial park and discharge to Barranca Channel after passing the station boundary. Proposed land uses within the industrial park include light industry and commercial establishments. For the purposes of this ROD/RAP, this land use was assumed over the next 30 years in this area. Human exposure to VOC-contaminated groundwater is unlikely in the industrial park because it is within the service area of an existing, high-quality municipal water supply system.

Alternative 2 does not include engineered measures to address the potential downward migration of 1,2,3-TCP from the second WBZ to the third WBZ through a localized lithologic discontinuity identified at IRP-13S. Additional discontinuities may exist downgradient of the existing OU-1A plumes. The third WBZ is considered a transition zone between the shallow groundwater system at Former MCAS Tustin and the regional aquifer, which is used as a drinking water source. Downward movement of 1,2,3-TCP in groundwater at IRP-13S is, therefore, a pathway that could lead to human exposure to VOCs. The monitoring component of Alternative 2 is intended to track this possibility. Periodic reviews of the monitoring data would trigger implementation of additional remedial measures if potential impacts on the regional aquifer are identified.

A final consideration for off-station migration involves potential ecological impacts that could result from the eventual discharge of VOCs originating on Former MCAS Tustin property to Barranca Channel. Because the discharges of VOC-impacted groundwater to surface water are not expected to begin for almost 40 years, it is difficult to predict potential impacts to ecological resources in the drainage channels or in downstream areas. Monitoring and periodic reviews under Alternative 2 would be used to more accurately evaluate the significance of the future discharges, and contingency measures would be implemented to mitigate any expected environmental impacts.

Institutional controls in the form of land-use restrictions would be used to prevent human exposure to contaminated shallow groundwater as long as VOC concentrations remain above health-based remediation goals; to protect the remedial action; and to allow the DON, DTSC, and their authorized agents, employees, contractors, and subcontractors access to the premises to maintain the remedial action. These land-use restrictions would be implemented through two different legal mechanisms: 1) covenant agreements with the DTSC and 2) deed restrictions. A discussion of the institutional controls and the methods of implementation can be found in Sections 10.4 and 10.5 of this ROD/RAP. A performance monitoring program with periodic progress reviews would be an integral component of this alternative.

8.2.3 Alternative 3 – Hydraulic Containment

Hydraulic containment would use a combination of engineering and administrative controls to limit further migration of the OU-1A groundwater plumes and prevent human exposure to VOC-contaminated groundwater. One extraction well would be placed along the downgradient margin of each plume identified in the first and second WBZs. The capture zones created by these wells would create a hydraulic barrier to effectively restrict further downgradient migration of VOCs within the shallow aquifer. Extracted groundwater would be treated at an aboveground facility located near IRP-13S and then discharged to a city of Tustin storm drain ultimately discharging into Peters Canyon Channel. The treatment system would be similar in design to the existing TCRA system at IRP-13S. Sampling requirements will be detailed in the OMP.

The basis for the development of Alternative 3 is similar to that described for Alternative 2. Currently, there are no complete human exposure pathways for groundwater contamination originating at IRP-13S. Estimated risks for potential exposure pathways under the planned reuse scenarios are relatively low, except for a future residential receptor. The exposure assumptions used to estimate future residential risks might not be as high realistically as indicated in the FS Report (BEI 2003b). In addition, residential exposures to contaminated groundwater are readily controlled through institutional measures such as lease or deed restrictions.

The principal benefit of implementing Alternative 3 is that VOCs would not migrate beyond the existing plume boundaries. Contamination would be kept within the Former MCAS Tustin property, enhancing the feasibility of the institutional controls necessary to minimize future risks. Containment under Alternative 3 would entail extraction of contaminated groundwater from both the first and second WBZs. While not primarily intended as an aquifer restoration alternative, this remedial action would, over time, realize a potentially significant reduction in both VOC mass and concentration within the plumes and accomplish risk reduction as well.

Other considerations supporting the development of a hydraulic containment alternative at Former MCAS Tustin are based on site hydrogeology and plume geometry. Given the limited transmissivities associated with the upper two WBZs, only one or two wells would be needed to contain each of the identified plumes. Two wells, each extracting groundwater at 3 gpm, would be required in each WBZ to contain the plumes at IRP-13S. Placement of the hydraulic containment wells at IRP-13S could be optimized during remedial design to eliminate the potential downward migration of 1,2,3-TCP from the second WBZ to the third WBZ, thereby reducing potential risk to the regional aquifer.

Institutional controls in the form of land-use restrictions would be used to prevent human exposure to contaminated shallow groundwater as long as VOC concentrations remain above health-based remediation goals; to protect the remedial action; and to allow the DON, DTSC, and their authorized agents, employees, contractors, and subcontractors access to the premises to maintain the remedial action. These land-use restrictions would be implemented through two different legal mechanisms: 1) covenant agreements with the DTSC and 2) deed restrictions. A discussion of the institutional controls and methods of implementation is in Sections 10.4 and 10.5 of this ROD/RAP. A performance monitoring program with periodic progress reviews would be an integral component of this alternative.

8.2.4 Alternatives 4/4A – Aggressive Groundwater Extraction With Off-Site Soil Disposal/On-Site Soil Treatment

Alternatives 4 and 4A include excavating VOC-contaminated soil to expedite cleanup and installing a network of groundwater extraction and injection wells to contain the OU-1A plumes, reduce VOC concentrations, and restore the shallow aquifer to beneficial uses as quickly as possible. Alternatives 4 and 4A differ only in the disposition of the excavated source-area soil. All other components of these two alternatives are identical.

Alternatives 4 and 4A were based on modeling that indicated that source-area soil removal combined with an aggressive 15-year groundwater extraction program should remove enough VOC mass to permanently prevent contaminant migration exceeding remediation goals beyond the boundaries of Former MCAS Tustin property. The soil source removal component focuses on the most highly contaminated materials within the vadose zone and the upper confining layer of the first WBZ. Ultimately, groundwater extraction would be expected to remove the bulk of the VOC mass from the permeable sand layers of the first and second WBZs.

Source-area soil removal would entail excavation of contaminated soil with TCE- and 1,2,3-TCP at concentrations greater than 100 µg/kg and 10 µg/kg, respectively, within the upper confining layer of the first WBZ at IRP-13S. The purpose of the removal would be to accelerate the rate of remediation in the underlying permeable sand layers and maximize the overall efficiency of the remedial action. Removal of soil exceeding this criterion represents an optimum balance between the volume of excavated material that must be managed and reductions in long-term VOC loadings to groundwater.

Alternative 4 evaluated off-site disposal of excavated soil. Excavated soils would be segregated into groups according to expected concentrations of TCE and 1,2,3-TCP. The stockpiled material would be tested to determine its classification under both federal and California hazardous waste management regulations and disposed of accordingly. Confirmation samples would be collected at the bottom of each excavation to demonstrate removal of all soil with TCE and 1,2,3-TCP at concentrations exceeding 100 and 10 µg/kg, respectively.

Alternative 4A evaluated on-site treatment of source-area soils with concentrations of TCE greater than 100 µg/kg or 1,2,3-TCP greater than 10 µg/kg using a thermal desorption unit (TDU). Thermal desorption is a physical process in which soil is heated to temperatures between 200 and 1,000 °F, causing VOCs to vaporize from the soil matrix. A carrier gas or vacuum system transports the volatilized water and organics to a vapor treatment system where the contaminants are destroyed thermally. As a CERCLA remediation activity conducted entirely on-site, the use of a TDU at the site would not require a permit from South Coast Air Quality Management District (SCAQMD). However, treated vapors released to the atmosphere would need to be handled in accordance with the substantive provisions of the SCAQMD regulations pertaining to point source emissions of VOCs. Local vendors would be required to employ an SCAQMD "various locations" permit for portable TDUs. The treated soil would be placed in the excavated area as backfill.

Groundwater would be extracted using wells located throughout the entire area of affected groundwater at and downgradient from IRP-13S (for purposes of the FS, 18 wells were estimated to be needed). The total groundwater extraction rate based on the conceptual design in the FS would be 45 gpm from each of the first and second WBZs for a combined rate of 90 gpm. Groundwater extraction would continue until contaminant levels in the sand layers of the first two WBZs reached asymptotic levels. Extraction for longer periods of time would not result in significant additional contaminant reduction. After the extraction systems are shut down, natural attenuation processes would continue to reduce VOCs to remediation goals.

Treated groundwater would be discharged through approximately 18 injection wells into the first and second WBZs of the shallow aquifer. Injection of treated groundwater upgradient of the contaminant plume would enhance flushing of VOCs to the extraction wells (thus reducing the time required for aquifer restoration) while diverting clean (upgradient) groundwater around the areas of contamination. The injection wells would be located in areas of the shallow aquifer where background levels of TDS and other inorganic constituents are not markedly different from the treated groundwater.

Institutional controls in the form of land-use restrictions would be used to prevent potential human exposure to contaminated shallow groundwater as long as VOC concentrations remain above health-based remediation goals; to protect the remedial action; and to allow the DON, DTSC, and their authorized agents, employees, contractors, and subcontractors access to the premises to maintain the remedial action. These land-use restrictions would be implemented through two different legal mechanisms: 1) covenant agreements with the DTSC and 2) deed restrictions. A discussion of the institutional controls and methods of implementation is in Sections 10.4 and 10.5 of this ROD/RAP. A performance monitoring program with periodic progress reviews would be an integral component of this alternative.

8.2.5 Alternative 5 – Permeable Reaction Wall

Alternative 5 consists of permeable reaction walls installed within the shallow aquifer to remediate the VOC plumes downgradient from IRP-13S. Similar to Alternative 3, the overall objectives of the permeable reaction wall alternative would be to contain the OU-1A plumes, achieve significant reductions in VOC concentrations, and prevent human exposure to VOC-affected groundwater.

Permeable reaction walls represent technology that would require a pilot test before full-scale implementation. However, studies reported in the literature have shown that TCE, 1,2,3-TCP, and other chlorinated VOCs can be completely degraded to nonchlorinated, nontoxic reaction products as groundwater flows through an *in situ* bed of reactive iron. This was confirmed in bench tests using groundwater samples collected from the OU-1A plumes (BNI 1998a). Long-term success of the permeable reaction walls would be evaluated using groundwater monitoring results after the remedy is in place. However, during the BCT meeting of 29 October 2002, the RAB for Former MCAS Tustin and the RWQCB stated their opposition to the application of this iron reactive-wall technology at OU-1A. Alternative 5 was retained for evaluation, however, to be consistent with the FS conducted for OU-1B and for further consideration as an innovative technology.

For conceptual design purposes, the walls are assumed to be used in a funnel-and-gate configuration, with slurry walls directing (funneling) the contaminated groundwater through permeable sections of reactive iron. The slurry walls and permeable reaction walls would be configured such that all upgradient groundwater within the plumes would eventually pass through the iron via natural groundwater flow. The permeable reaction walls would extend vertically to effectively intercept VOC-affected groundwater in both the first and second WBZs. Low levels of existing VOC contamination downgradient from the walls would be remediated by natural attenuation processes, including dilution, dispersion, and adsorption.

Institutional controls in the form of land-use restrictions would be used to prevent human exposure to contaminated shallow groundwater as long as VOC concentrations remain above health-based remediation goals; to protect the remedial action; and to allow the DON, DTSC, and their authorized agents, employees, contractors, and subcontractors access to the premises to maintain the remedial action. These land-use restrictions would be implemented through two different legal mechanisms: 1) covenant agreements with the DTSC and 2) deed restrictions. A discussion of the institutional controls and methods of implementation is in Sections 10.4 and 10.5 of this ROD/RAP. A performance monitoring program with periodic progress reviews would be an integral component of this alternative. Periodic reviews would be conducted to evaluate system performance and determine the need for flushing or replacement of the reactive iron materials.

8.2.6 Alternatives 6/6A – Vacuum-Enhanced Extraction With Off-Site Soil Disposal/On-Site Soil Treatment

Alternatives 6 and 6A are refinements of Alternatives 4 and 4A. They include source-area soil removal plus groundwater extraction to contain the OU-1A plumes while attempting to shorten the time required to remediate VOC-affected groundwater. Alternatives 6 and 6A differ only in the disposition of the excavated source-area soil. Similar to disposal of excavated soil under Alternative 4, excavated soil under Alternative 6 would be segregated based on VOC concentrations, the soil stockpiles would be profiled, and contaminated soil would be disposed of off-site. Similar to Alternative 4A, Alternative 6A would treat contaminated soil on-site using a TDU. Alternative 6A includes use of the excavated soil as backfill. All other components of these two alternatives are identical.

Alternatives 6 and 6A would impose a high vacuum (approximately 0.3 to 0.4 atmosphere was estimated in the FS Report) on the groundwater extraction wells completed in the first WBZ. The purpose of the VEE system would be to increase the groundwater extraction rate and thus the rate of VOC removal from the sand layer of the first WBZ. Additional contaminants would be removed with soil vapor captured by the vacuum system as the groundwater table is lowered in the vicinity of the VEE wells and VOCs are stripped from newly exposed soil. Conventional groundwater extraction wells would be installed to remove dissolved contaminants from the second WBZ. Modeling results presented in the FS Report suggest that four VEE wells and four conventional groundwater extraction wells would be required and that the optimal total groundwater extraction rate from the first two WBZs would be a combined rate of 72 gpm.

The extracted groundwater would be treated by GAC to remove organic contaminants at an aboveground treatment facility constructed near IRP-13S. Treated groundwater would be discharged in a manner identical to Alternative 3. Groundwater extraction would continue until contaminant concentrations in the sand layers of the first two WBZs reached asymptotic levels. Based on the modeling results in the FS Report (BEI 2003b), extraction is expected to continue for 15 years at IRP-13S. Extraction for a longer period of time would not result in significant additional contaminant reduction. After the extraction systems are shut down, natural processes (dilution, dispersion, and adsorption) would continue to reduce VOC concentrations to remediation goals.

The modeling results in the FS Report also predicted that VEE wells at the site could remove a combined total of 0.9 standard cubic foot per minute of soil gas. In contrast, the VEE pilot test conducted at a nearby site (IRP-3) found that vapor flow in these wells is unlikely because residual moisture in the upper clay layer in the first WBZ acts as an effective barrier to air circulation from the surface (BNI 1999a). Nevertheless, because extraction of soil gas is theoretically possible with a VEE system, provisions to handle VOC-containing vapors would be included in the design of the treatment facility.

Institutional controls in the form of land-use restrictions would be used to prevent human exposure to contaminated shallow groundwater as long as VOC concentrations remain above health-based remediation goals; to protect the remedial action; and to allow the DON, DTSC, and their authorized agents, employees, contractors, and subcontractors access to the premises to maintain the remedial action. These land-use restrictions would be implemented through two different legal mechanisms: 1) covenant agreements with the DTSC and 2) deed restrictions. A discussion of the institutional controls and methods of implementation is in Sections 10.4 and 10.5 of this ROD/RAP. A performance monitoring program with periodic progress reviews would be an integral component of this alternative.

8.2.7 Alternative 7 – Hydraulic Containment With Hot Spot Removal

Alternative 7 is an enhancement or optimization of Alternative 3 that combines hydraulic containment with soil and groundwater hot spot removal. Hot spot soils (soils with TCE concentrations greater than 400 µg/kg within the vadose zone and upper confining layer of the first WBZ) would be excavated. Soils with TCE concentrations exceeding 100 µg/kg would be treated on-site using a TDU. Treated soil would be used as excavation backfill. Hot spot groundwater and soil removal optimizes hydraulic containment by reducing the time required to attain the remediation goals established for the site. Treated water from the treatment system would be discharged to a city of Tustin storm drain, ultimately discharging into Peters Canyon Channel.

For purposes of the FS, it was assumed that groundwater extraction under Alternative 7 would use the identical extraction well configuration as for hydraulic containment under Alternative 3 (i.e., four hydraulic containment wells placed at the downgradient margins of the plumes in the first and second WBZs) plus one additional hot spot groundwater extraction well placed in the area of highest VOC concentrations in groundwater. The purpose of the more aggressive hot spot groundwater extraction under Alternative 7 is to reduce the highest contaminant concentrations in groundwater, thereby reducing the time required for remediation. Groundwater extraction using the additional hot spot well would continue until contaminant levels in groundwater extracted from the hot spot well reached asymptotic levels. Based on the modeling results, groundwater extraction using the hot spot well is expected to continue for 6 years at IRP-13S (BEI 2003b).

The total groundwater extraction rate from the five wells extracting groundwater from the first two WBZs would be 18 gpm for years 0 to 6 and 12 gpm for years 6 to 30. Extraction for longer periods of time would not result in significant additional contaminant reduction. After the extraction systems are shut down, natural processes would continue to reduce VOCs to remediation goals.

Institutional controls in the form of land-use restrictions would be used to prevent human exposure to contaminated shallow groundwater as long as VOC concentrations remain above health-based remediation goals; to protect the remedial action; and to allow the DON, DTSC, and their authorized agents, employees, contractors, and subcontractors access to the premises to maintain the remedial action. These land-use restrictions would be implemented through two different legal mechanisms: 1) covenant agreements with the DTSC and 2) deed restrictions. A discussion of the institutional controls and methods of implementation is in Sections 10.4 and 10.5 of this ROD/RAP. As with Alternatives 3 and 4/4A, Alternative 7 has the advantage of limiting the areas where deed restrictions would be required, since the extent of VOC-affected groundwater would not expand significantly beyond current plume boundaries.

A performance monitoring program with periodic progress reviews would be an integral component of Alternative 7. The specifics of the monitoring program, including the sampling frequency, number of samples, and locations and specifications for any new monitoring wells (e.g., depths, screened intervals, construction materials), would be determined during the remedial design/remedial action phase and documented in the OMP for OU-1A. Additionally, disposal options for treated groundwater would be reevaluated in the remedial design and would consider factors such as local hydrogeology, substantive regulations, regulatory/public input, and current discharge limits. The disposal options to be reevaluated include, but are not limited to, surface discharge, unit treatment processes, infiltration, sewer discharge, or other beneficial uses such as irrigation.

Section 9
SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

This section summarizes results from the comparative analysis conducted to evaluate the relative advantages and disadvantages of each remedial alternative in relation to the nine evaluation criteria outlined in CERCLA Section 121(b), as amended. A more detailed discussion of the alternatives evaluated for IRP-13S is presented in the OU-1A FS Report (BEI 2003b).

CERCLA evaluation criteria are based on requirements promulgated in the NCP. As stated in the NCP (40 C.F.R. § 300.430[f]), evaluation criteria are arranged in the following hierarchical manner: threshold criteria, primary balancing criteria, and modifying criteria. Threshold criteria must be satisfied in order for an alternative to be eligible for selection. Primary balancing criteria are used to weigh major trade-offs among alternatives. Generally, modifying criteria are taken into account after public comments are received on the Proposed Plan.

Threshold Criteria:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs

Primary Balancing Criteria:

- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume
- Short-Term Effectiveness
- Implementability
- Cost

Modifying Criteria:

- State Acceptance
- Community Acceptance

Table 9-1 summarizes the comparative analysis of the OU-1A alternatives. Computer-based groundwater modeling supported the analysis by assessing the effect of each alternative on VOC contamination. The modeling was used primarily to evaluate long-term effectiveness; short-term effectiveness (i.e., time to achieve remediation goals); and reduction of toxicity, mobility, or volume of contaminants. Modeling for IRP-13S was performed using Vadose Zone Leaching Model, Modular Three-Dimensional Finite-Difference Groundwater Flow Model, and MT3D computer codes with supporting information taken primarily from the RI Report (BNI 1997b), the 1997 Annual Groundwater Monitoring Report (BNI 1998b), and the Final 1999 Annual Groundwater Monitoring Report (BNI 2000a).

Table 9-1
Summary of Comparative Analysis of OU-1A Remedial Alternatives

Criterion	Alternative 1 No Action	Alternative 2 Monitored Natural Attenuation	Alternative 3 Hydraulic Containment	Alternatives 4/4A Aggressive Groundwater Extraction	Alternative 5 Permeable Reaction Wall	Alternatives 6/6A Vacuum-Enhanced Extraction	Alternative 7 Hydraulic Containment With Hot Spot Removal
Short-term effectiveness	○	◑	◕	◔	◔	◔	●
Long-term effectiveness and permanence	○	○	◑	◕	◔	◑	●
Reduction of toxicity, mobility, or volume through treatment	○	○	◑	◕	◑	◕	◕
Implementability	●	●	◕	◑	○	◑	◕
Cost	●	●	◕	◑	○	◑	◕
Compliance with ARARs	Not applicable	Complies	Complies	Complies	Complies	Complies	Complies
Overall protection of human health and the environment	Not Protective	Not Protective	Protective	Protective	Protective	Protective	Protective

Acronyms/Abbreviations:
ARAR – applicable or relevant and appropriate requirement
NCP – National Oil and Hazardous Substances Pollution Contingency Plan
OU – operable unit

Relative Performance in Satisfying NCP Criteria

○	◔	◑	◕	●
Low	Low to Moderate	Moderate	Moderate to High	High

9.1 THRESHOLD CRITERIA

Threshold criteria include overall protection of human health and the environment and compliance with ARARs. An alternative must meet both threshold criteria to be eligible for selection.

9.1.1 Overall Protection of Human Health and the Environment

Assesses whether a remedy provides adequate public health protection and describes how health risks posed by the site will be eliminated, reduced, or controlled through treatment, engineering controls, or institutional and regulatory controls.

Alternatives 3, 4/4A, 5, 6/6A, and 7 are protective of human health and the environment. These alternatives would satisfy OU-1A RAOs because they would:

- prevent human exposure to VOCs in shallow groundwater through institutional controls (deed restrictions and permits required for new water supply wells);
- contain the OU-1A plumes within existing boundaries;
- prevent the off-station migration of contaminated groundwater and eliminate the potential for future VOC discharges to Peters Canyon Channel and Barranca Channel;
- substantially reduce TCE and 1,2,3-TCP mass and maximum concentrations over 30 years, thereby reducing potential risk to human health and the environment;
- provide a permanent solution to existing groundwater contamination;
- comply with all identified ARARs and eventually achieve remediation goals throughout the areas currently affected by the OU-1A plumes;
- track and verify the progress of groundwater remediation through a systematic program of long-term monitoring and periodic site reviews; and
- limit the area covered by deed restrictions to approximately 54 acres; in all cases, the required deed restrictions should be compatible with redevelopment of the Former MCAS Tustin property.

In addition to these benefits, Alternatives 4 and 4A, 6 and 6A, and 7 would remove VOC-affected soils from the source areas at OU-1A.

Alternative 5 (permeable reaction wall) would provide many of the same advantages as those listed above for Alternatives 3, 4/4A, 6/6A, and 7. However, Alternative 5 is rated slightly less protective of overall human health and the environment for three reasons. First, the long-term performance of this alternative was considered uncertain because the hardness in shallow groundwater would increase the potential for chemical precipitates to foul the reactive iron. Second, deep iron-wall installations required to remediate the plumes in the second WBZ at IRP-13S may be difficult to construct. Finally, because it is a passive process, Alternative 5 would not actively reverse the potential for farther downward migration of 1,2,3-TCP into the third WBZ.

Alternative 2 (monitored natural attenuation) was not considered protective of human health and the environment. Alternative 2 would prevent human exposure to VOCs in shallow groundwater through institutional controls. However, contaminant mass would not be reduced in the subsurface. Monitored natural attenuation would allow significant expansion of the OU-1A plumes on the Former MCAS Tustin property and would not prevent plume migration to off-station areas, which would result in the eventual discharge of VOCs to Barranca Channel. For these reasons, Alternative 2 is considered not to be protective of human health and the environment. Continued migration of VOC-affected groundwater could also have a negative effect on site redevelopment. The deficiencies identified for Alternative 2 could be mitigated somewhat by long-term monitoring and periodic reviews, which would track plume movement and provide a basis for additional remedial actions.

Alternative 1 would have the same drawbacks noted above for Alternative 2 without the benefits of either deed restrictions or long-term monitoring. Although there is no current human exposure to VOCs in shallow groundwater at MCAS Tustin, redevelopment of the property may change this situation over time. Alternative 1 would not provide the engineering or additional institutional controls included with the other alternatives to mitigate future risks. Therefore, overall protection of human health and the environment was considered unacceptable under Alternative 1.

9.1.2 Compliance With Applicable or Relevant and Appropriate Requirements

Addresses whether a remedy will meet all federal, state, and local environmental statutes or requirements.

Alternative 3 (hydraulic containment), Alternatives 4 and 4A (aggressive groundwater extraction with off-site soil disposal and with on-site soil treatment, respectively), Alternative 5 (permeable reaction wall), Alternatives 6 and 6A (VEE with off-site soil disposal and with on-site soil treatment, respectively), and Alternative 7 (hydraulic containment with hot spot removal) would comply with all chemical-, location-, and action-specific ARARs identified for OU-1A. Alternatives 4/4A, 6/6A, and 7 would be designed to contain the plumes and restore the shallow aquifer to remediation goals to the extent practicable. The hydraulic containment and permeable reaction wall alternatives would be designed to control migration of contaminated groundwater. While not intended as aquifer-restoration alternatives, both Alternatives 3 and 5 would offer potentially significant reductions in contaminant mass and would attain remediation goals within the existing boundaries of the OU-1A plumes, but in a time frame generally greater than 100 years.

Alternative 2 (monitored natural attenuation) would eventually satisfy the chemical-specific ARARs for the shallow aquifer system, which are driven by RWQCB's classification of the underlying Irvine Pressure Subbasin (regional aquifer) as a potential source of drinking water supply. However, compliance with state action-specific ARARs would be problematic for Alternative 2, particularly for those requirements related to maintenance of beneficial uses and water quality objectives (WQOs) in the shallow aquifer.

ARARs are not triggered by Alternative 1 (no action).

9.2 PRIMARY BALANCING CRITERIA

Primary balancing criteria include long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; and cost. These are used to weigh trade-offs among alternatives and identify the most favorable.

9.2.1 Long-Term Effectiveness and Permanence

Refers to the ability of a remedy to continue protecting human health and the environment over time after the remedial action is completed.

For each alternative, long-term effectiveness and permanence were evaluated on the basis of model-based predictions of groundwater quality. The modeling results presented in the FS Report suggest that several alternatives could achieve remediation goals given sufficient time (BEI 2003b). However, the shallow aquifer system underlying MCAS Tustin is heterogeneous, with potentially significant quantities of contamination adsorbed to low-permeability clay layers. These adsorbed VOCs are difficult to remediate and may serve as a continuing source of contamination to the more transmissive sand and gravel layers. It is difficult to model the long-term effect that VOCs released from the clay layers could have on water quality in the first and second WBZs. Thus, complete aquifer restoration by groundwater extraction or *in situ* treatment may not be technically practicable within a reasonable time, despite model predictions indicating otherwise.

With this qualification, Alternative 7 (hydraulic containment with hot spot removal) was determined to provide the best overall long-term performance among the remedial options evaluated during the FS. Alternative 7 would also use proven and reliable technology to remove and treat contaminated soil and groundwater. As predicted by modeling results in the FS, maximum concentrations of TCE would fall below the remediation goal of 5 µg/L within 15 years of implementing Alternative 7; maximum concentrations of 1,2,3-TCP in the first and second WBZs would still exceed the remediation goal of 0.5 µg/L after more than 60 years (Figures 9-1 through 9-3).

Alternatives 4 and 4A (aggressive groundwater extraction with off-site soil disposal and with on-site soil treatment, respectively) were the next best options in terms of long-term effectiveness. Alternatives 4 and 4A use proven and reliable technology, prevent significant plume migration beyond existing boundaries, and eliminate future contaminant discharges of groundwater to Barranca Channel. Although heterogeneities in the shallow aquifer system may ultimately preclude complete aquifer restoration, Alternatives 4 and 4A would at least contain the OU-1A plumes and prevent human exposure to VOCs through institutional controls.

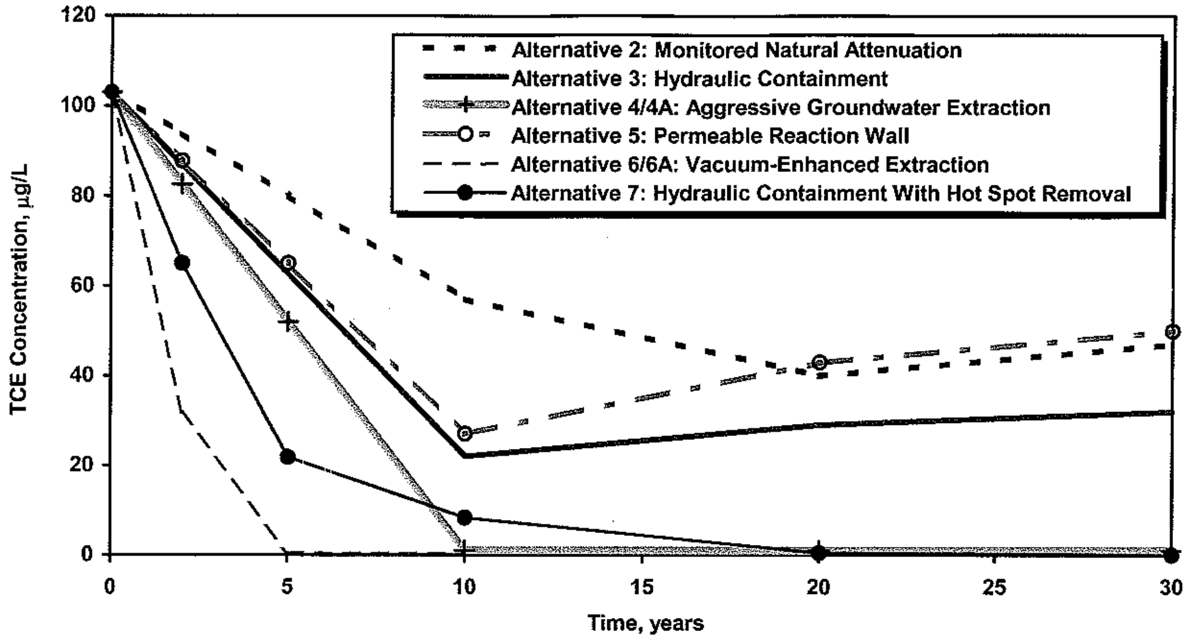


Figure 9-1
Maximum Predicted TCE Concentrations in the First WBZ at IRP-13S

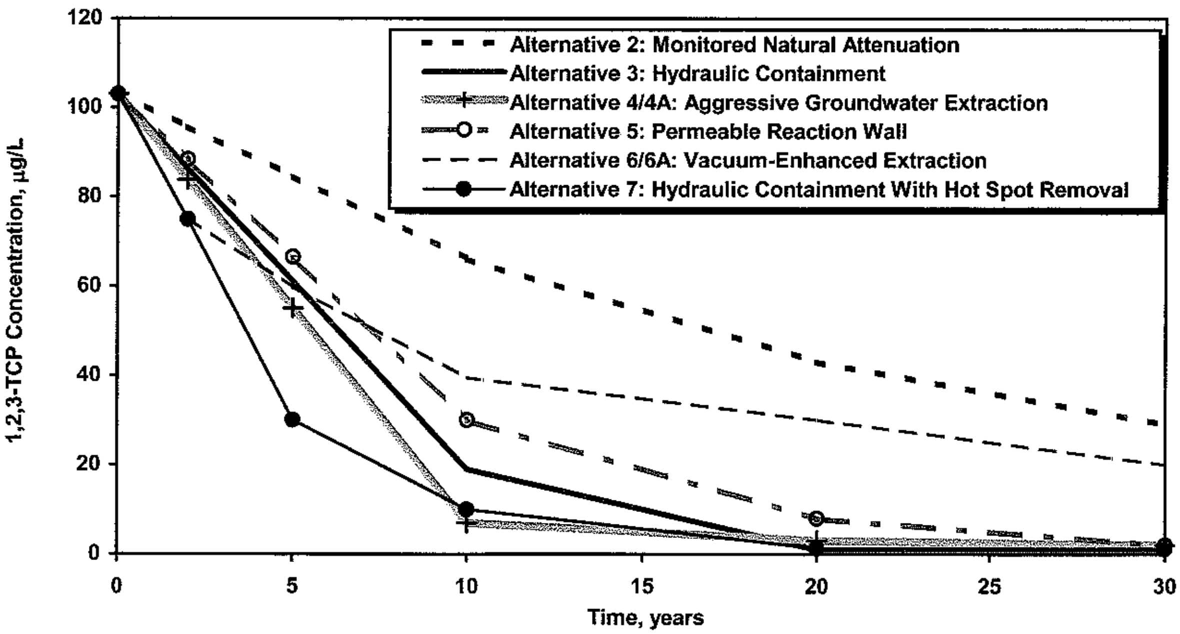


Figure 9-2
Maximum Predicted 1,2,3-TCP Concentrations in the First WBZ at IRP-13S

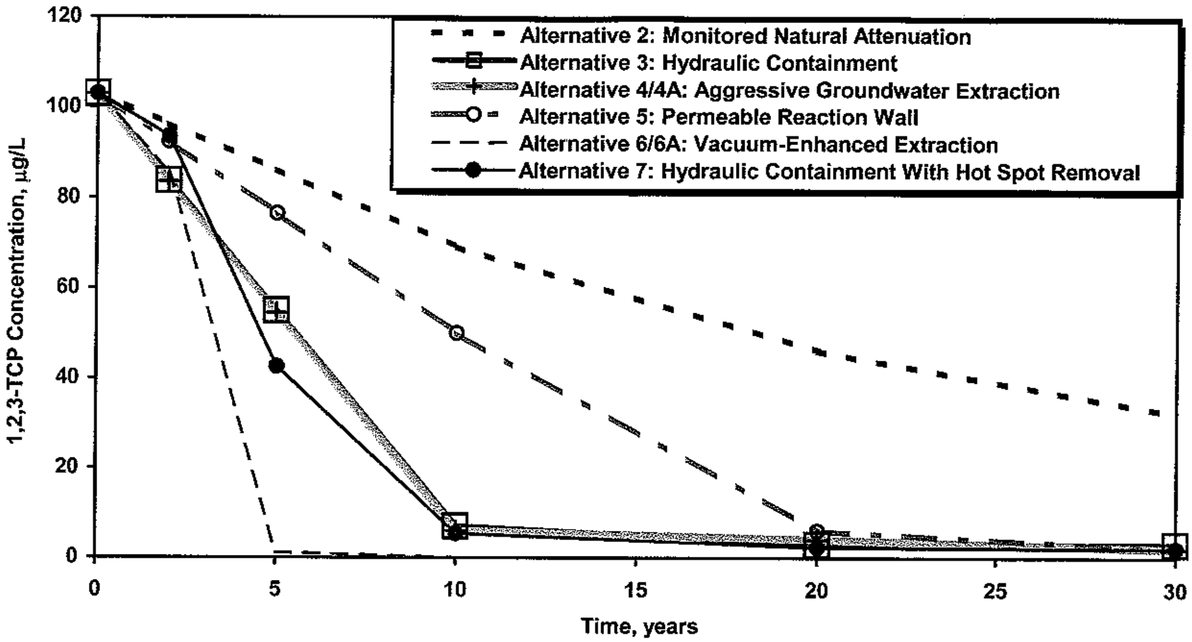


Figure 9-3
Maximum Predicted 1,2,3-TCP Concentrations in the Second WBZ at IRP-13S

Alternatives 6 and 6A (VEE with off-site soil disposal and with on-site soil treatment, respectively) were rated slightly less effective than aggressive groundwater extraction in the long term. While these options would have many of the same advantages as Alternatives 4 and 4A, a recent field test at a nearby site (IRP-3) suggests that model-based predictions of high groundwater-extraction rates for a VEE system may not be realized in practice (BNI 1999a).

Alternative 3 (hydraulic containment) was also rated as less favorable than Alternatives 4/4A and 7 with respect to long-term effectiveness and permanence. The major advantages of hydraulic containment are that it would prevent human exposure to VOCs (through institutional controls) and further migration of contaminated groundwater (through extraction at the downgradient plume margins). The major disadvantage of this option is that it could potentially require continued operation and maintenance (O&M) of the groundwater extraction-and-treatment system for many decades beyond the 30-year period considered in the FS.

The long-term effectiveness and permanence of Alternative 5 (permeable reaction wall) were considered lower than those of Alternatives 4/4A and 7. Permeable reaction walls employ innovative technology, and the performance of this technology over several decades is uncertain. Alternative 5 would significantly reduce maximum TCE and 1,2,3-TCP concentrations and, therefore, risk at OU-1A. However, residual contaminant concentrations after 30 years would generally be greater than they would be under several other alternatives, primarily because Alternative 5 would rely on natural groundwater flow to transport VOCs to the reactive iron wall.

Alternative 1 (no action) and Alternative 2 (monitored natural attenuation) were the least attractive options from the standpoint of long-term effectiveness and permanence because they would allow significant expansion of the contaminated plume and would potentially allow human (Alternative 1) and ecological (Alternatives 1 and 2) exposure to contaminated groundwater.

9.2.2 Reduction of Toxicity, Mobility, or Volume

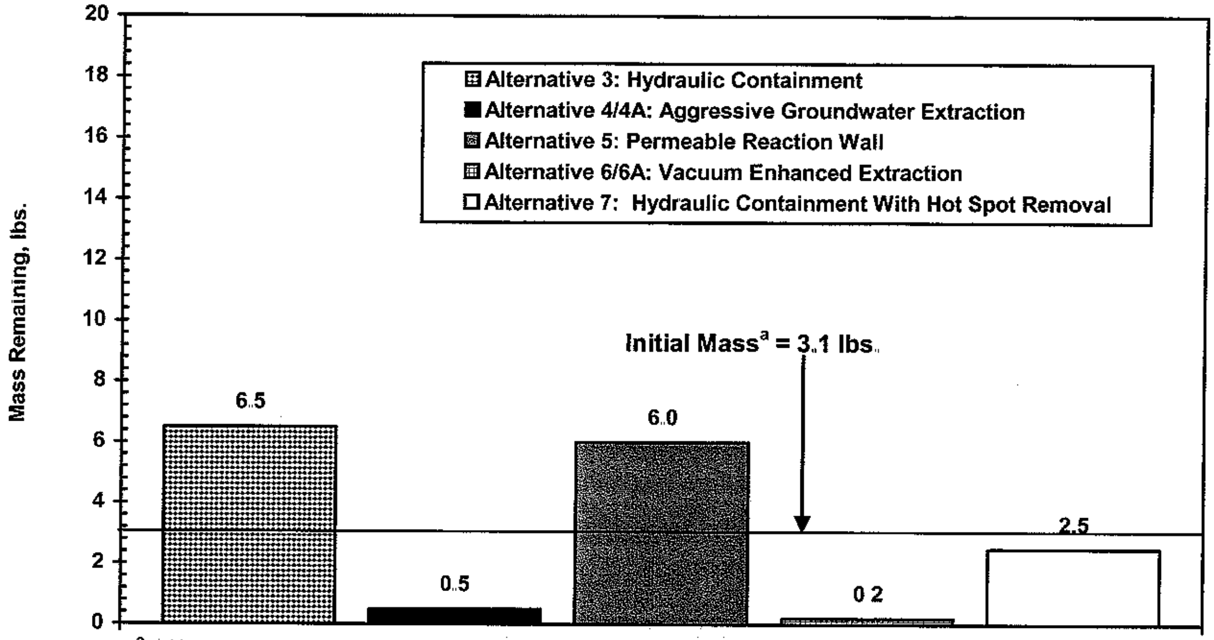
This criterion assesses the degree to which the alternatives employ recycling or treatment that reduce 1) harmful effects to human health and the environment (toxicity), 2) the contaminant's ability to move (mobility), and 3) the amount of contamination (volume), including how treatment is used to address the primary threats posed by the site.

Based on initial modeling results in the FS, Alternatives 6 and 6A (VEE with off-site soil disposal and with on-site soil treatment, respectively) were predicted to achieve the greatest reduction in contaminant mass (more than 97 and 80 percent of the overall mass of TCE and 1,2,3-TCP, respectively) over the 30-year period considered in the FS (Figures 9-4 and 9-5). However, the predictions assume that high groundwater extraction rates can be attained with VEE, and results from pilot-scale tests conducted at IRP-3 showed that VEE rates were only marginally higher than standard pumping rates (BNI 1999a). Thus, the contaminant-mass reductions actually achievable with Alternatives 6 and 6A are likely equivalent to those with Alternatives 4, 4A, and 7.

Alternative 7 removes VOC mass using hot spot extraction wells, containment wells, and soil excavation. Based on the modeling used in the FS, it was estimated that over 30 years, this alternative would remove approximately 73 percent of the TCE mass and over 65 percent of the 1,2,3-TCP mass.

Modeling results in the FS for Alternatives 4 and 4A (aggressive groundwater extraction with off-site soil disposal and with on-site soil treatment, respectively) predicted the residual TCE and 1,2,3-TCP mass would be reduced by approximately 95 and 74 percent, respectively, through a combination of groundwater extraction and treatment along with soil excavation and either landfill disposal (Alternative 4) or on-site thermal treatment and disposal (Alternative 4A).

Predicted VOC removals were lower for Alternative 3 (hydraulic containment) and Alternative 5 (permeable reaction wall), which would reduce the VOC mass by approximately 48 and 55 percent, respectively. Alternative 3 would control VOC mobility through plume containment; the toxicity and volume of contaminated groundwater would gradually be reduced through extraction at the downgradient plume margins and treatment of the extracted water. Alternative 5 would reduce contaminant toxicity, mobility, and volume through *in situ* reductive dehalogenation of VOCs as the OU-1A plumes pass through sections of reactive iron.



[a] = Note that for some alternatives, the residual mass exceeds the initial mass due to leaching from the soil source area into the saturated zone.

Figure 9-4
Residual TCE Mass at IRP-13S After 30 Years

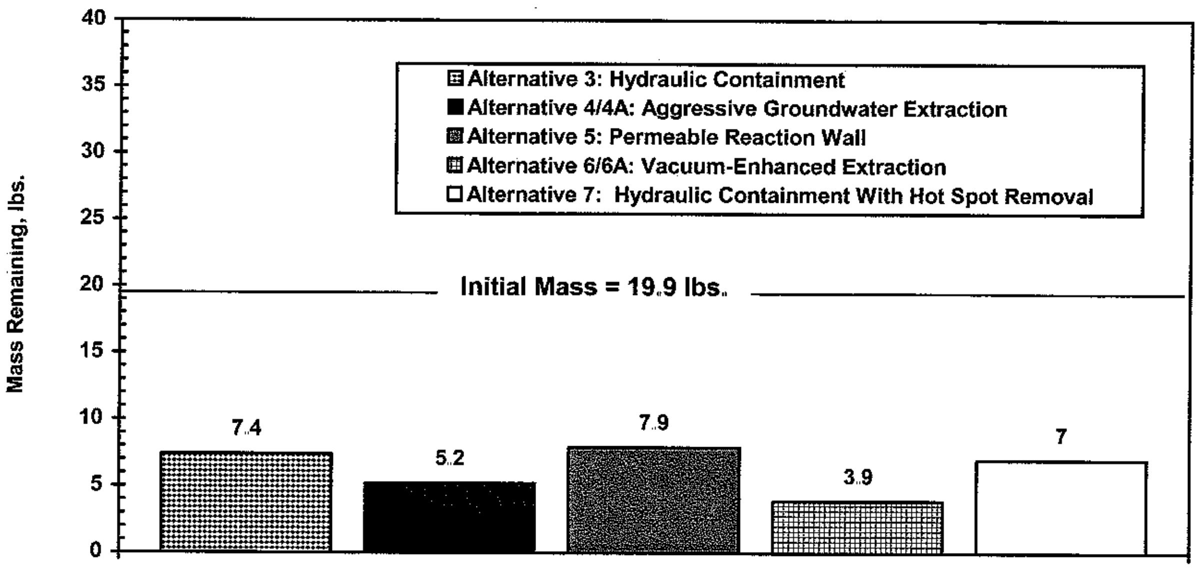


Figure 9-5
Residual 1,2,3-TCP Mass at IRP-13S After 30 Years

Alternative 1 (no action) and Alternative 2 (monitored natural attenuation) would result in no reduction in contaminant toxicity, mobility, or volume other than that attributable to dilution, dispersion, and adsorption in the subsurface. Maximum VOC concentrations would decrease significantly over 30 years. However, there would be no decrease in the mass of TCE, since chlorinated VOC biodegradation is assumed to be negligible under the prevailing aerobic conditions of the shallow aquifer. The OU-1A plumes would continue to migrate into areas currently unaffected by VOCs, increasing the overall volume of contaminated groundwater over time.

9.2.3 Short-Term Effectiveness

The short-term effectiveness criterion assesses how well human health and the environment will be protected from impacts due to construction and implementation of a remedy. It also considers time required to reach remediation goals.

Considering all the factors listed in the U.S. EPA RI/FS guidance (U.S. EPA 1988b), Alternative 7 (hydraulic containment with hot spot removal) was rated the most effective option in the short term. This alternative would involve limited-scale remedial activities and would be unlikely to have adverse short-term impacts on workers or the surrounding community. The combination of institutional and engineering controls in Alternative 7 would effectively limit further migration of the OU-1A plumes and reduce potential human exposure to VOC-affected groundwater. This option is relatively more effective in achieving remediation goals (in approximately 15 years TCE concentrations are predicted to reach the MCL; concentrations of 1,2,3-TCP would slightly exceed the MCL at that time) than hydraulic containment alone.

Alternative 1 (no action) was determined to be the least effective option in the short term. The OU-1A plumes would continue to expand in the downgradient direction, and VOC concentrations in the first and second WBZs would remain above remediation goals for more than 100 years.

Alternative 2 (monitored natural attenuation) would present few risks during field implementation. Deed restrictions and the long-term groundwater monitoring program could be in place within a year after this ROD/RAP is finalized. However, Alternative 2 would not prevent further migration of the OU-1A plumes, and remediation goals would not be achieved for more than 100 years. Consequently, monitored natural attenuation was considered to be among the least effective alternatives in the short term primarily because of the length of time required to mitigate the major threats associated with OU-1A.

Alternative 3 effectively prevents plume migration but does not reach remediation goals for more than 100 years in most cases. Requiring no soil excavation, Alternative 3 presents fewer risks to workers and the surrounding community than does Alternative 7. Deed restrictions would effectively prevent exposure to contaminated groundwater until remediation goals are met.

Alternatives 4 and 4A (aggressive groundwater extraction with off-site soil disposal and with on-site soil treatment, respectively), Alternative 5 (permeable reaction wall), and Alternatives 6 and 6A (VEE with off-site soil disposal and with on-site soil treatment, respectively) were all rated less effective than Alternative 7 with respect to short-term effectiveness. The major components of these alternatives could be in place 9 months (Alternatives 4, 4A, 6, and 6A) to 3 years (Alternative 5) after mobilization for field construction. Once implemented, these alternatives would prevent or significantly reduce migration of the OU-1A plumes and control human exposure to VOCs in shallow groundwater. Assuming that restoration of the shallow aquifer at MCAS Tustin is technically feasible, the time required to attain remediation goals was estimated to generally be from 50 to 90 years for Alternatives 4/4A and 6/6A and more than 100 years for Alternative 5. In addition, these alternatives would all entail relatively large-scale excavation of contaminated soil.

9.2.4 Implementability

Refers to the technical feasibility (how difficult the remedy is to construct and operate) and the administrative feasibility (coordination with other agencies) of a remedy. Factors such as availability of materials and services needed are considered.

Alternatives 1 and 2 are the most readily implemented because they entail no action (Alternative 1) or couple institutional controls with minimal construction (Alternative 2). The next best alternatives with regard to implementability are Alternative 3 (hydraulic containment), Alternatives 4 and 4A (aggressive groundwater extraction with off-site soil disposal and with on-site soil treatment, respectively), and Alternative 7 (hydraulic containment with hot spot removal). Hydraulic containment, hot spot removal, and aggressive groundwater extraction methods would employ reliable, widely available technologies and would use conventional equipment and construction methods for installation. In addition, Alternatives 3, 4/4A, and 7 would not raise unusually complex or difficult administrative issues.

For technical reasons, Alternatives 6 and 6A (VEE with off-site soil disposal and with on-site soil treatment, respectively) were considered less implementable than Alternatives 3, 4/4A, and 7. The benefits of using VEE to enhance groundwater capture in the first WBZ are uncertain, based on the results of pilot-scale testing (BNI 1999a). Otherwise, Alternatives 6 and 6A would use proven and reliable technologies and construction methods. The VEE options were also determined to be administratively implementable.

Alternative 5 (permeable reaction wall) has the lowest rating for implementability because of both technical and administrative issues. This alternative would be only marginally more effective than standard groundwater extraction. The hardness of the shallow groundwater at OU-1A could possibly cause chemical precipitation on the surface of the reactive iron, adversely affecting long-term performance. In addition, it is uncertain whether permeable reaction walls could be constructed to remediate the deep contamination associated with the plumes in the second WBZ at the site. The deed restrictions required by Alternative 5 would constrain redevelopment on those parcels overlying the permeable reaction walls. In addition, only one process vendor markets the technology, further reducing the administrative implementability of this option.

9.2.5 Cost

This criterion evaluates the alternatives in terms of estimated capital costs and present worth in today's dollars required for design and construction and long-term O&M costs of a remedy.

Table 9-2 presents the net present cost estimates developed for the nine OU-1A remedial alternatives. These alternatives were grouped into three relatively low-cost options (under $3.5 million), five midrange-cost options (approximately $4.5 to $7.8 million), and one high-cost option (approximately $11 million).

Among the low-cost options, the least expensive was Alternative 1 (no action), which has no associated cost. At a net present cost of $0.8 million, Alternative 2 (monitored natural attenuation) was the next most attractive option from a cost standpoint. Alternative 3 (hydraulic containment) was somewhat more expensive with a net present cost of $3.8 million.

Net present costs for the midrange options, including Alternative 7 (hydraulic containment with hot spot removal), Alternatives 4 and 4A (aggressive groundwater extraction), and Alternatives 6 and 6A (VEE), are estimated to range from $4.3 to $8.5 million. Total capital costs for Alternative 7 could be reduced up to approximately 45 percent if components of the existing TCRA system (extraction and monitoring well installation, piping, electrical distribution, and GAC treatment system) are incorporated into the final remedy. In addition, the estimated net present cost of Alternative 6 could increase by $0.5 million to approximately $6.9 million if additional VEE wells are required to contain the OU-1A plumes and obtain the desired groundwater extraction rates in the first WBZ. A similar increase would also apply to Alternative 6A. Given the accuracy of the cost-estimation procedures used in the FS (-30 to +50 percent), the $2.1 to $2.0 million cost difference between Alternatives 4 and 6 and Alternatives 4A and 6A is not significant. For purposes of this comparative analysis, the costs of aggressive groundwater extraction and VEE should be considered equivalent.

The most expensive remedial option was Alternative 5 (permeable reaction wall) at a net present cost of $19.0 million. The high cost of this alternative resulted from several factors: the installation of the deep and relatively thick reactive iron walls, the transportation and off-site disposal of contaminated soils removed during the initial construction, the assumed need to replace the reactive iron after 15 years, the licensing fee paid to the process vendor, the initial pilot study, and installation of new monitoring wells.

Table 9-2
Summary of Cost Estimates for OU-1A Remedial Alternatives
(dollars in millions)

Alternative	Total Capital Cost	Total O&M Cost[a]	Total Cost	Net Present Value[b]
Alternative 1 no action	0	0	0	0
Alternative 2 monitored natural attenuation	0.3	1.7	2.0	0.8
Alternative 3 hydraulic containment	0.7	8.0	8.7	3.8
Alternative 4 aggressive groundwater extraction with off-site soil disposal	4.4	7.0	11.4	8.5
Alternative 4A aggressive groundwater extraction with on-site soil treatment	3.7	6.9	10.6	7.6
Alternative 5 permeable reaction wall	10.0	21.2	31.2	19.0
Alternative 6 vacuum-enhanced extraction with off-site soil disposal	3.0	6.0	9.0	6.4[c]
Alternative 6A vacuum-enhanced extraction with on-site soil treatment	2.3	5.8	8.1	5.6[c]
Alternative 7 hydraulic containment with hot spot removal	1.2[d]	7.8	9.0	4.3

Notes:

[a] includes other indirect costs, escalation, and contingency during assumed 30-year project duration

[b] in 2002 dollars

[c] cost of Alternatives 6 and 6A may increase by up to $0.5 million if additional VEE wells are required; actual extraction rates in the first WBZ could be as low as 5 gpm per well, as obtained in a recent VEE field test (BNI 1999a), rather than the 12 gpm per well estimated by the model in Appendix B of the FS Report (BEI 2003b)

[d] total capital costs could be reduced up to approximately 45 percent if components of the existing TCRA system (extraction and monitoring well installation, piping, electrical distribution, and GAC treatment system) are incorporated into the final remedy

Acronyms/Abbreviations:

GAC – granular activated carbon
gpm – gallons per minute
O&M – operation and maintenance
OU – operable unit
TCRA – time-critical removal action
VEE – vacuum-enhanced extraction
WBZ – water-bearing zone

9.3 MODIFYING CRITERIA

Modifying criteria include state and community acceptance. State acceptance is taken into account during development of the proposed plan and ROD/RAP. Public acceptance is considered through comments received during the public comment period.

9.3.1 State Acceptance

This criterion reflects whether the state of California's environmental agencies agree with, oppose, or have no objection to or comment on the DON's preferred alternative.

DTSC and RWQCB have reviewed the OU-1/OU-2 RI, the OU-1A FS, and the OU-1A Proposed Plan and concur with the selected remedy for groundwater remediation at IRP-13S.

9.3.2 Community Acceptance

This criterion evaluates whether community concerns are addressed by the remedy and if the community has a preference for a remedy. Although public comment is an important part of the final decision, the DON is compelled by law to balance community concerns with other criteria.

The Proposed Plan has been presented to the community and discussed at a public meeting. The responsiveness summary portion of this ROD/RAP addresses the public's comments and concerns about the selected remedy.

Section 10
SELECTED REMEDY

The remedy the DON has selected for OU-1A is Alternative 7: hydraulic containment with hot spot removal (with the off-site disposal component of Alternative 4 replacing the on-site treatment component of Alternative 7). This selection is based on the RI and FS Reports for OU-1A, the administrative record for this site, and an evaluation of comments submitted by interested parties during the public comment period.

This section presents the conceptual design for hydraulic containment with hot spot removal. Design details and other specifications will be evaluated and established during the remedial design phase of the project. These specifics include exact number and placement of extraction and monitoring wells, extraction well pumping rates, performance monitoring, and other related design components, including disposal or reuse of clean, treated groundwater.

10.1 SOIL HOT SPOT EXCAVATION

The excavation and disposal of contaminated soil under the selected remedy consist of components from Alternative 7 (hot spot soil removal) and Alternative 4 (off-site soil disposal). According to the conceptual designs for Alternatives 4 and 7, soil with elevated concentrations of TCE would be removed from the vadose zone and upper confining layer of the first WBZ at IRP-13S and disposed of off-site (Figure 10-1). The on-site component for treatment of hot spot soils using a TDU under Alternative 7 was determined to be infeasible based on several factors (see Section 12). Therefore, the hot spot soil removal component of Alternative 7 was combined with the off-site disposal component of Alternative 4. Specific details on soil excavation and disposal will be provided in the remedial design.

The rationale for removing these hot spot soils is to eliminate potential sources of low-level VOC contamination to groundwater in the first WBZ. The soils targeted for excavation will be those portions of the vadose zone and upper confining layer of the first WBZ with TCE at concentrations exceeding 400 µg/kg. This value was chosen because at this concentration, the soil will act as a continuing source of contamination to groundwater, resulting in concentrations of TCE exceeding the MCL. These targeted soils generally occur at depths of approximately 3 to 15 feet bgs. Using this 400 µg/kg criterion in the conceptual model in the FS for evaluation purposes, approximately 2,450 cubic yards of soil will be excavated from one area at IRP-13S (Figures 10-2 and 10-3).

Soil will be excavated to the interface with groundwater (anticipated to be approximately 15 feet bgs) to ensure contaminated soil with the potential to impact groundwater is removed. Soil samples will be collected from the sidewalls of the excavation to guide the excavation and document residual TCE contamination. Excavated soil contaminated with TCE at concentrations greater than 100 µg/kg will be transported to a permitted off-site disposal facility. Clean fill consisting of sand or gravel will be obtained from an off-site commercial source, combined with clean excavated soil, and used to backfill the excavated area.

2

10.2 GROUNDWATER EXTRACTION

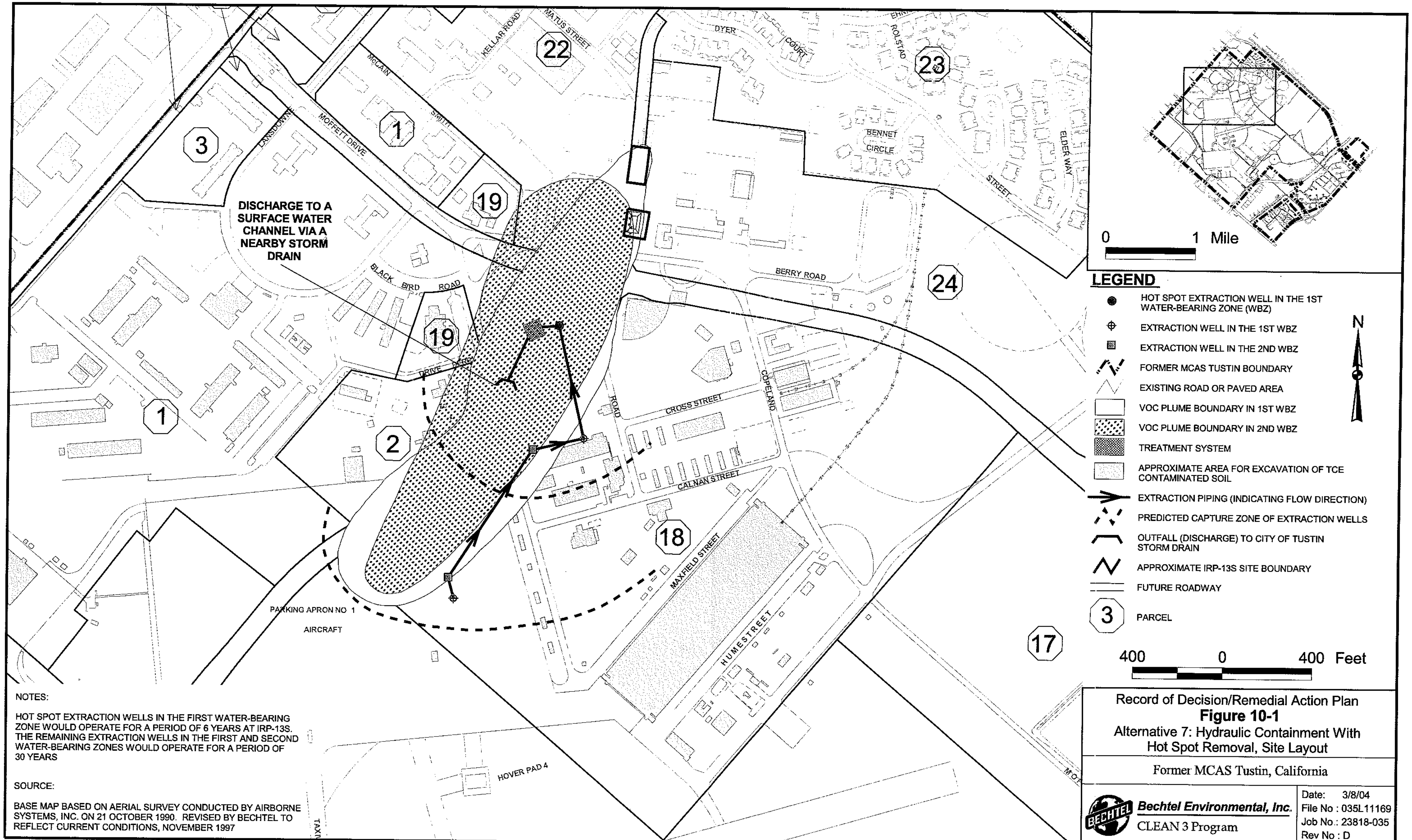
The conceptual design used for evaluation purposes in the FS includes five groundwater extraction wells, comprising one hot spot extraction well and four hydraulic containment wells. Figure 10-1 depicts proposed locations of the five wells at IRP-13S, including two containment wells and one hot spot extraction well in the first WBZ and two containment wells in the second WBZ. The hot spot extraction well will be located near the highest VOC concentrations in the contaminant plume and will operate for approximately 6 years. Hydraulic containment wells will operate for 30 years. The conceptual design was prepared using a groundwater model that incorporated site-specific hydrogeologic conditions encountered at IRP-13S and an iterative approach to optimize hydraulic containment by varying the number, placement, and pumping rates of hot spot extraction and hydraulic containment wells. The exact number, placement, and pumping rates of all wells will be determined during the remedial design phase.

Operation of the hydraulic containment and hot spot extraction wells will create cones of depression that will capture contamination from the leading margins and from the central portions of the plumes, preventing further horizontal or vertical migration of VOCs in the upper two WBZs. Table 10-1 summarizes the proposed completion depths, pumping rates, and durations for the extraction wells. The actual extraction well locations, pumping rates, and completion depths will be determined during remedial design.

Extracted groundwater will be conveyed to an equalization tank at the site. The equalization tank will be used to prevent flow surges caused by cyclic operation of pumps in individual extraction wells. From the equalization tank, the extracted groundwater will be pumped through a cartridge filtration system followed by two-stage GAC adsorption. GAC is a proven and reliable method for removing VOCs from groundwater. It has been identified by U.S. EPA as a presumptive *ex situ* treatment for groundwater contaminated with VOCs (U.S. EPA 1996b). Treatability studies would not be needed to design and install this technology at Former MCAS Tustin. Figures 10-4 and 10-5 show the predicted distribution of 1,2,3-TCP and TCE over time at IRP-13S.

Thirty years of operation would produce approximately 16,500 pounds of spent GAC. Regeneration or disposal of the spent carbon will be the responsibility of the GAC supplier under a long-term service contract. It is assumed that the spent GAC will be taken off-site for regeneration, which is the typical practice on groundwater remediation projects. Before it is shipped from the Former MCAS Tustin site, the spent GAC will be tested to determine its waste classification. Characterization, packaging, and transport of this material will be in accordance with Department of Transportation, U.S. EPA, and DTSC requirements.

Disposal options for groundwater were evaluated in the FS for their effectiveness, implementability, and cost. Based on this initial evaluation, discharge to the storm drain was considered to be the most appropriate disposal option and is the selected disposal option in this ROD/RAP. However, other disposal options evaluated in the FS will be reevaluated during the remedial design phase in order to consider additional factors such



NOTES:

HOT SPOT EXTRACTION WELLS IN THE FIRST WATER-BEARING ZONE WOULD OPERATE FOR A PERIOD OF 6 YEARS AT IRP-13S. THE REMAINING EXTRACTION WELLS IN THE FIRST AND SECOND WATER-BEARING ZONES WOULD OPERATE FOR A PERIOD OF 30 YEARS

SOURCE:

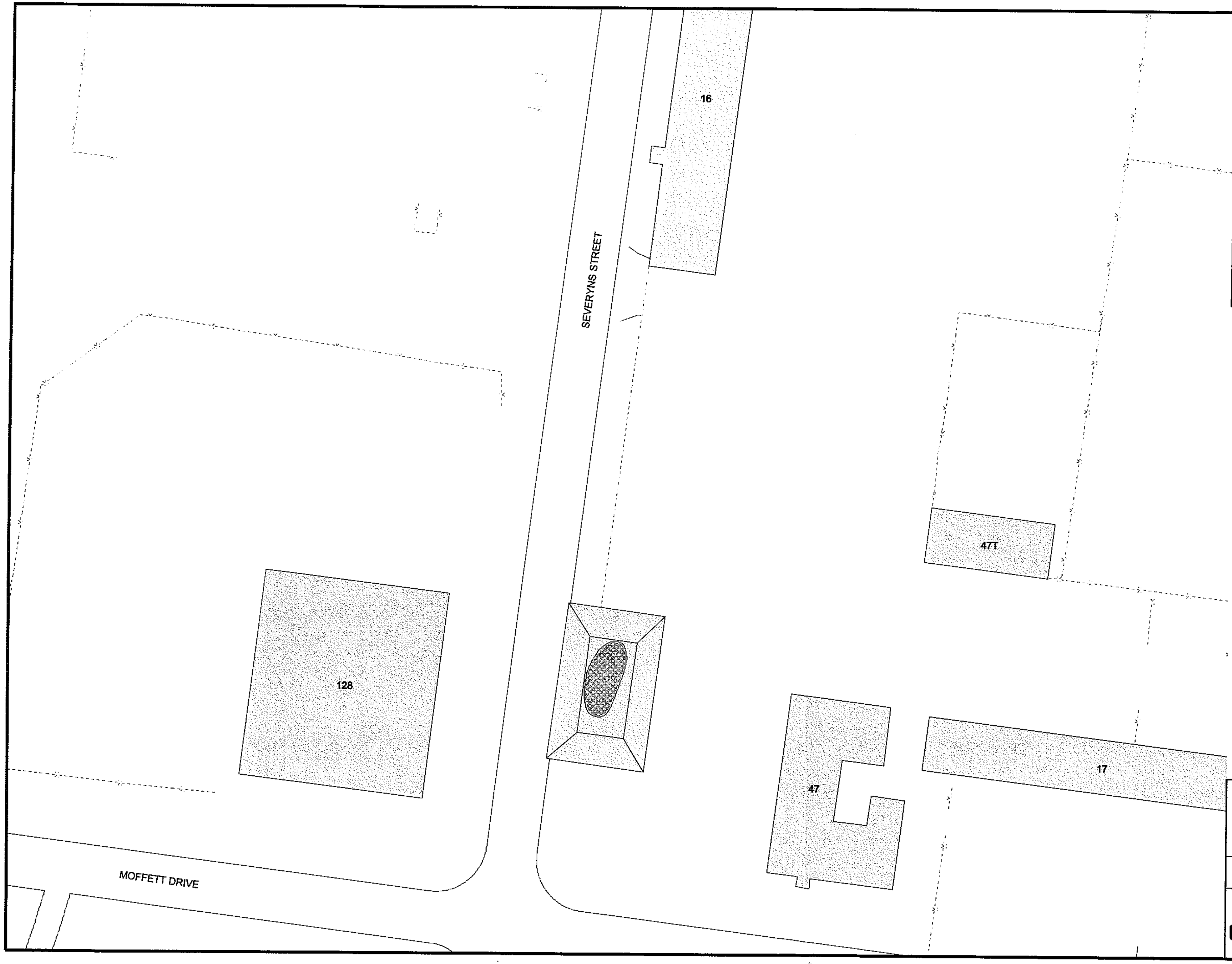
BASE MAP BASED ON AERIAL SURVEY CONDUCTED BY AIRBORNE SYSTEMS, INC. ON 21 OCTOBER 1990. REVISED BY BECHTEL TO REFLECT CURRENT CONDITIONS, NOVEMBER 1997

Record of Decision/Remedial Action Plan
Figure 10-1
Alternative 7: Hydraulic Containment With Hot Spot Removal, Site Layout

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 3/8/04
File No : 035L11169
Job No.: 23818-035
Rev No : D



Record of Decision/Remedial Action Plan

Figure 10-2

Alternative 7: Extent of TCE Soil Contamination > 400 µg/kg and Excavation Area at IRP-13S

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 3/4/04
File No.: 035L11170
Job No.: 23818-035
Rev No.: H

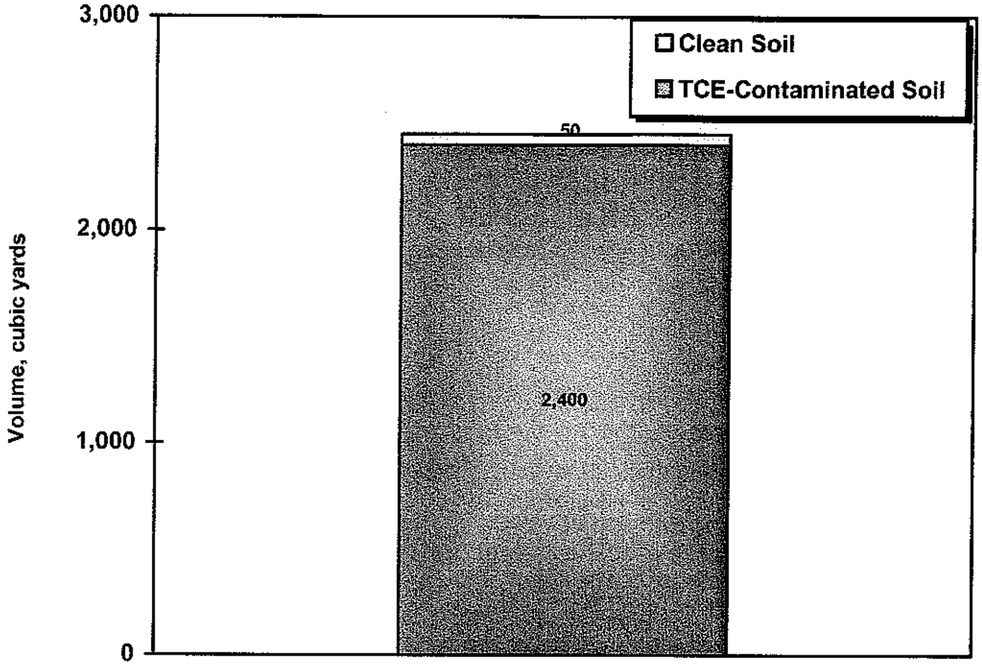


Figure 10-3
Volume of Soil to Be Excavated Under Alternative 7

as local hydrogeology, substantive regulations, regulatory/public input, and current discharge limits. The disposal options to be reevaluated include, but are not limited to, surface discharge, unit treatment processes, infiltration, sewer discharge, or other beneficial uses such as irrigation. If discharge to the storm drain is selected in the remedial design as the most appropriate disposal option, then treated water from the treatment system will be discharged (using single-walled piping) into a city of Tustin storm drain ultimately emptying into Peters Canyon Channel. The discharge will comply with substantive ARARs for surface water discharges. For potential storm drain discharges, the DON has reviewed the need to obtain an NPDES permit and has determined that such a permit will not be necessary. The groundwater treatment system associated with the selected remedy will be operated entirely on-site as defined under CERCLA and the NCP. After being discharged into a city of Tustin storm drain emptying into Peters Canyon Channel, the treated groundwater will ultimately discharge into waters of the United States at an off-site location. The U.S. EPA has consistently maintained that the migration of treated water beyond site boundaries (after the response action has treated the water so that it complies with ARARs) is consistent with the on-site permit exclusion in Section 121(e) of CERCLA and does not constitute an "off-site" response action that requires an NPDES permit (see *In the Matter of the Former Weldon Spring Ordnance Works*, Weldon Spring, Missouri, Federal Facility Docket No. VII-90-F-0033, 01 November 1995).

Table 10-1
Extraction Well Details for Hydraulic Containment With Hot Spot Removal

WBZ	Number of Wells	Completion Depth[a] (feet bgs)	PUMPING RATE Hot Spot Wells (gpm)	Containment Wells (gpm)	Combined (gpm)
First	2	30–34	NA	6[b]	NA
First	1	30–34	6	NA	NA
Second	2	55–60	NA	6[b]	NA
Total	**5**	**NA**	**6[b,c]**	**12**	**18/12[d]**

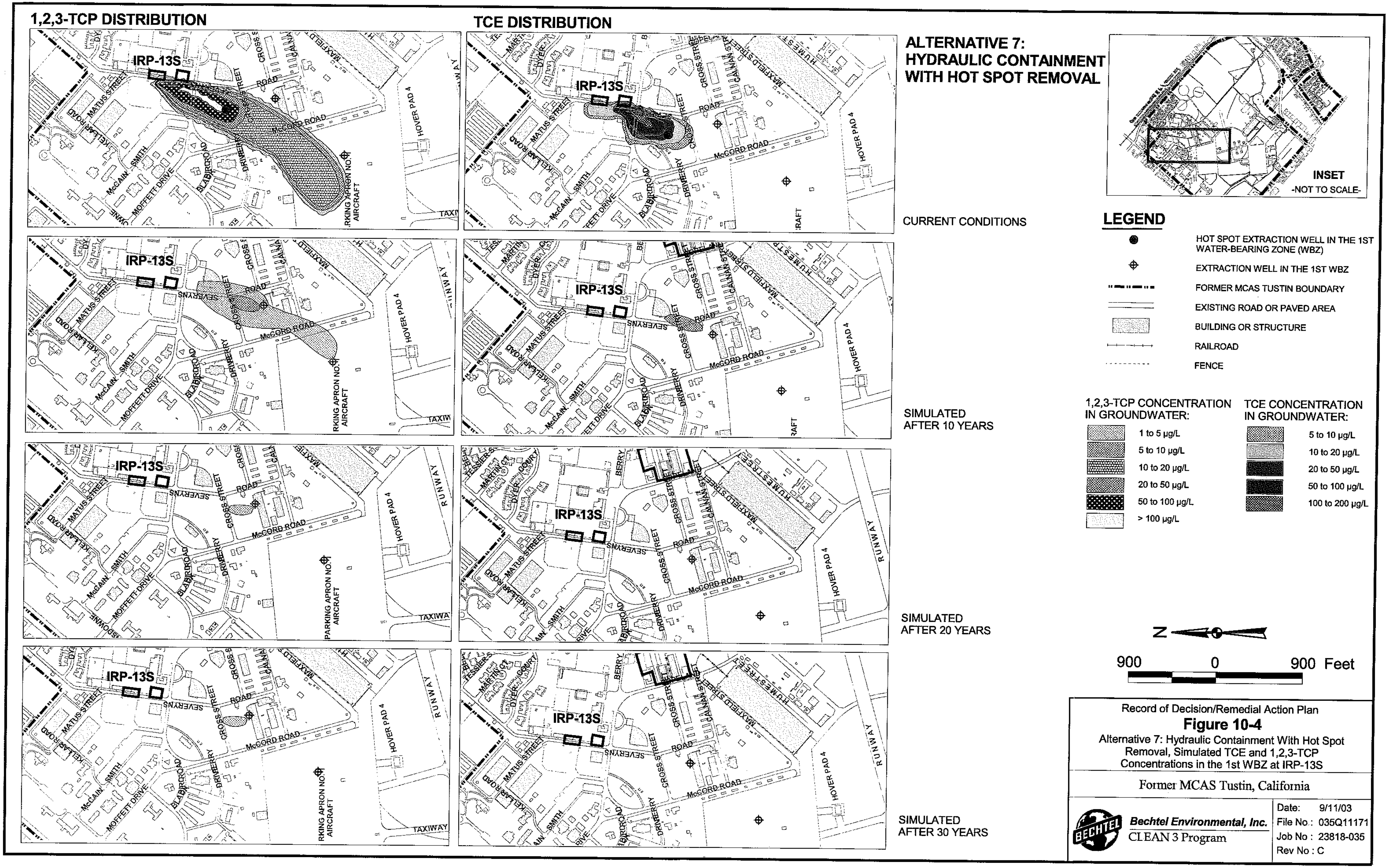
Notes:
[a] completion depths shown are estimated; actual depths would vary depending on conditions encountered at each location
[b] two containment wells would operate at 3 gpm each
[c] this well would operate for approximately 6 years after implementation of remedial alternative
[d] the total combined pumping rate would be 18 gpm for years 0 to 6 and 12 gpm for years 6 to 30

Acronyms/Abbreviations:
bgs – below ground surface
gpm – gallons per minute
NA – not applicable
WBZ – water-bearing zone

Although not required to obtain an NPDES permit, the DON will assure that the discharge of treated groundwater complies with all ARARs as provided by Section 121 of CERCLA and the NCP, including the beneficial uses and WQOs of the RWQCB. The DON plans to evaluate compliance with these ARARs by regularly monitoring the influent and effluent of the treatment system. Details of the monitoring will be developed during the remedial design/remedial action phase. The groundwater treatment subcontractor will be responsible for documentation of the on-site treatment activities. This documentation will consist of a summary report detailing quantities removed, treated, and discharged; discharge flow rates; the number and types of samples collected; and the results of analyses.

10.3 PERFORMANCE MONITORING

Performance monitoring will be used to optimize operation of the extraction system, track mass removal, verify containment of the OU-1A plumes, and demonstrate successful treatment of the extracted groundwater before discharge. Monitoring will include water-level measurements as well as the collection and analysis of samples from wells placed within the plume areas. Process streams within the treatment plant will also be tested. A summary of the anticipated performance monitoring for the selected alternative is presented in Table 10-2.



Record of Decision/Remedial Action Plan

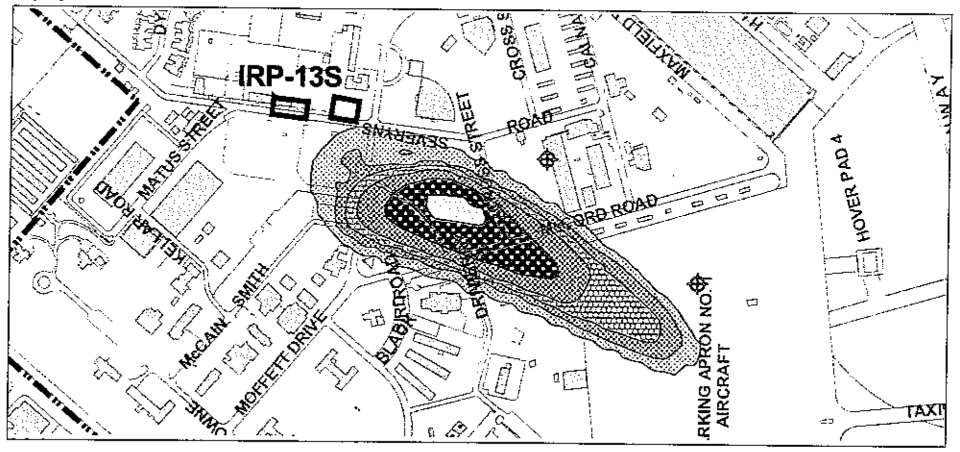
Figure 10-4

Alternative 7: Hydraulic Containment With Hot Spot Removal, Simulated TCE and 1,2,3-TCP Concentrations in the 1st WBZ at IRP-13S

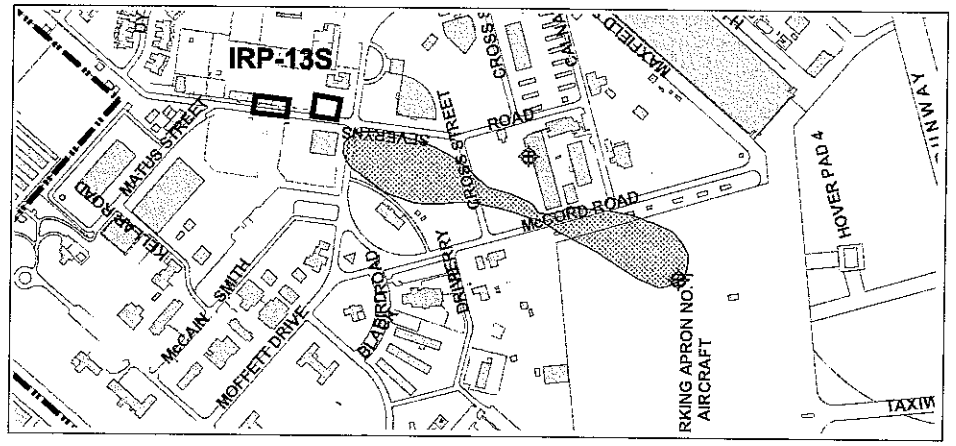
Former MCAS Tustin, California

1,2,3-TCP DISTRIBUTION

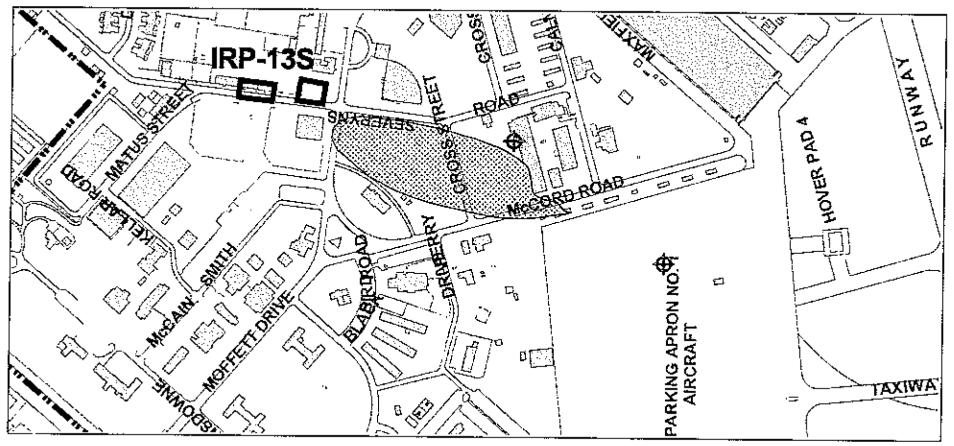
ALTERNATIVE 7: HYDRAULIC CONTAINMENT WITH HOT SPOT REMOVAL



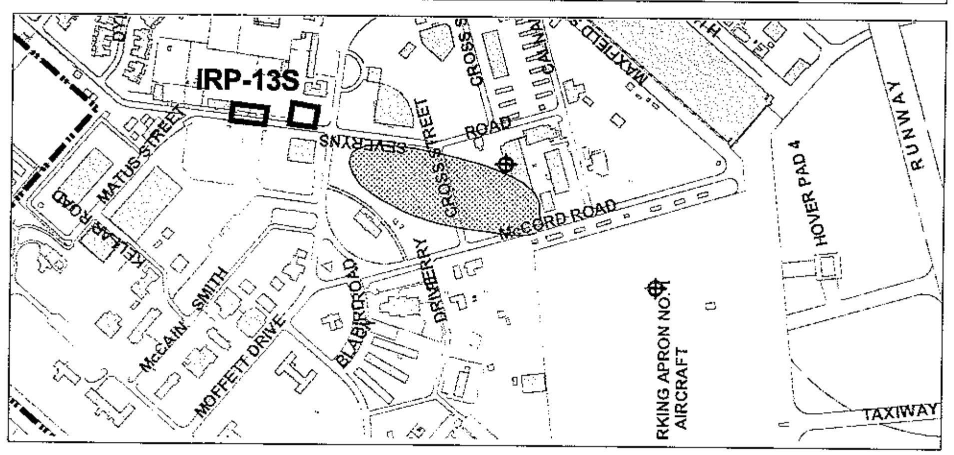
CURRENT CONDITIONS



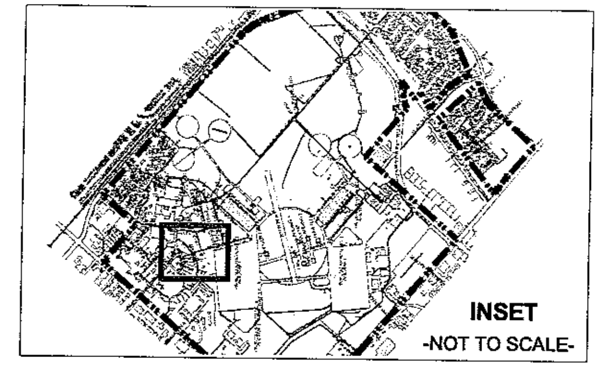
SIMULATED AFTER 10 YEARS



SIMULATED AFTER 20 YEARS



SIMULATED AFTER 30 YEARS



LEGEND

- EXTRACTION WELL IN THE 2ND WATER-BEARING ZONE (WBZ)
- FORMER MCAS TUSTIN BOUNDARY
- EXISTING ROAD OR PAVED AREA
- BUILDING OR STRUCTURE
- RAILROAD
- FENCE

1,2,3-TCP CONCENTRATION IN GROUNDWATER:

- 1 to 5 µg/L
- 5 to 10 µg/L
- 10 to 20 µg/L
- 20 to 50 µg/L
- 50 to 100 µg/L
- > 100 µg/L

N

900 0 900 Feet

Record of Decision/Remedial Action Plan

Figure 10-5

Alternative 7: Hydraulic Containment With Hot Spot Removal, Simulated 1,2,3-TCP Concentrations in the 2nd WBZ at IRP-13S

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 9/11/03
File No : 035Q11172
Job No : 23818-035
Rev No : C

Table 10-2
Performance Monitoring for Hydraulic Containment With Hot Spot Removal

Type of Monitoring Data	Monitoring Locations	Purpose/Use of Data
Water levels	Monitoring wells throughout and around the VOC plumes	Prepare potentiometric surface maps and hydrographs. Determine horizontal and vertical hydraulic gradients. Confirm capture zones (containment of plumes).
VOC concentrations in the shallow aquifer	Monitoring wells throughout and around the VOC plumes	Delineate areal and vertical extent of contamination. Confirm containment of plumes.
VOC concentrations in extracted groundwater	Extraction wells and equalization tank effluent	Estimate cumulative mass of VOCs removed from aquifer. Characterize extracted groundwater from individual wells and combined treatment plant influent with respect to RCRA and non-RCRA hazardous waste criteria.
General water quality parameters as well as VOC, SVOC, and metal concentrations in treatment plant effluent	Effluent lines from GAC vessels	Assess performance of treatment system. Demonstrate compliance with discharge requirements.
Flow rates	Extraction wells and various points in treatment system	Confirm that extraction and treatment systems are operating to specifications.
Other operational parameters (e.g., waterline pressures)	Various locations	Use as needed to assess proper operation or incipient failure of pumps and filters.

Acronyms/Abbreviations:
GAC – granular activated carbon
RCRA – Resource Conservation and Recovery Act
SVOC – semivolatile organic compound
VOC – volatile organic compound

On the basis of modeling used in the FS Report, groundwater monitoring is anticipated to be performed using four existing and two new groundwater monitoring wells. The actual number of monitoring wells to be sampled and the locations and specifications (depths, screened intervals, and well construction materials) for new monitoring wells will be determined during remedial design and documented in the OMP. This plan will also provide details on sampling procedures, target analytes, analytical methods, field and laboratory quality assurance/quality control, and reporting requirements. Well locations and surface-completion methods will consider accessibility along with the need to minimize impacts on redevelopment of the Former MCAS Tustin property. Groundwater monitoring will continue until the shutdown criteria presented in Section 10.7 are met.

10.4 INSTITUTIONAL CONTROLS

Institutional controls are nonengineering mechanisms to implement land-use restrictions that will be used to prevent exposure of future landowner(s) and/or user(s) of the property to hazardous substances and to maintain the integrity of the remedial action until remediation is complete and remediation goals have been achieved (Table 8-2). Land-use restrictions are necessary to assure the protectiveness of and prevent damage to or interference with the remedial action. Monitoring and inspections will be conducted to assure that the land-use restrictions are being followed.

The following are land-use control (LUC) objectives to be achieved through land-use restrictions for the site.

- Prohibit the installation of new groundwater wells of any type and prevent exposure to VOC-contaminated groundwater without prior review and written approval from the DON, DTSC, U.S. EPA, and RWQCB until remediation objectives have been achieved.
- Prohibit the installation of any well or other structure that has the potential to affect plume migration.
- Prohibit the alteration, disturbance, or removal of groundwater extraction and monitoring wells and associated piping and equipment (e.g., treatment system) without prior review and written approval from the DON, DTSC, U.S. EPA, and RWQCB.

The DON shall address institutional control implementation and maintenance actions, including periodic inspections in the Remedial Design Package to be developed and submitted to the FFSRA signatories for review and approval pursuant to the FFSRA. The Remedial Design Package is the CERCLA equivalent to the RCRA Corrective Measures Implementation Plans and Specifications listed in Section 10.3 of the FFSRA. The Remedial Design Package shall include a LUC remedial design section to describe more specific LUC implementation and enforcement actions including:

- requirements for a CERCLA 5-year remedy review;
- frequency and requirements for periodic monitoring or visual inspections;
- reporting results from monitoring and inspections;

- notification procedures to the regulatory agencies for planned property conveyance, corrective action required, and/or response to actions inconsistent with LUCs for the remedy;
- consultation with U.S. EPA, DTSC, RWQCB, and other government agencies regarding wording for land-use restrictions and parties to be provided copies of the language of the deed, once executed;
- identification of responsibilities for the DON, U.S. EPA, DTSC, RWQCB, other government agencies, and the new property owner for implementation, monitoring, reporting, and enforcement of LUCs;
- providing a list of LUCs with the expected duration; and
- providing maps identifying where LUCs are to be implemented.

The DON shall be responsible for implementing, inspecting, reporting, and enforcing the LUC objectives described in this ROD/RAP in accordance with the approved Remedial Design Package. Although the DON may later transfer some of these responsibilities to another party by contract, property transfer agreement, or other means, the DON shall retain ultimate responsibility for remedy integrity. Should any of the LUC objectives fail, the DON shall ensure that appropriate actions are taken to reestablish the protectiveness of the remedy and may initiate legal action to either compel action by a third party(ies) and/or recover the DON's costs for mitigating any discovered LUC violation(s). The LUC shall be maintained until the concentrations of hazardous substances in groundwater have been reduced to levels that allow for unlimited exposure and unrestricted use.

The DON and DTSC shall enter into a Covenant to Restrict Use of Property as provided in the Memorandum of Agreement Between the United States Department of the Navy and the California Department of Toxic Substances Control and attached covenant models (10 March 2000) prior to transfer of property impacted by remaining groundwater contamination at OU-1A. The Covenant to Restrict Use of Property shall conform to the models attached to this Memorandum of Agreement and incorporate land-use restrictions identified in the final Remedial Design Report. The Covenant to Restrict Use of Property shall address the real property containing the OU-1A groundwater plume and associated buffer zone. It shall be executed by DTSC and the Navy and shall be recorded in the county where the land is located. It shall run with the land and continue in perpetuity unless modified or terminated in accordance with applicable law.

The area requiring institutional controls at OU-1A is shown on Figure 10-6.

10.5 PERIODIC REVIEWS

As required by CERCLA Section 121(c), the DON will document in a summary report at least every 5 years 1) whether the remedy is expected to remain protective, 2) any deficiencies identified during the review, and 3) recommended specific actions to correct any deficiencies (DON 2001). If necessary, the 5-year review report will include descriptions of follow-on actions needed to achieve, or to continue to assure, protectiveness along with a timetable for these actions.

10.6 OPERATION AND MAINTENANCE PLAN

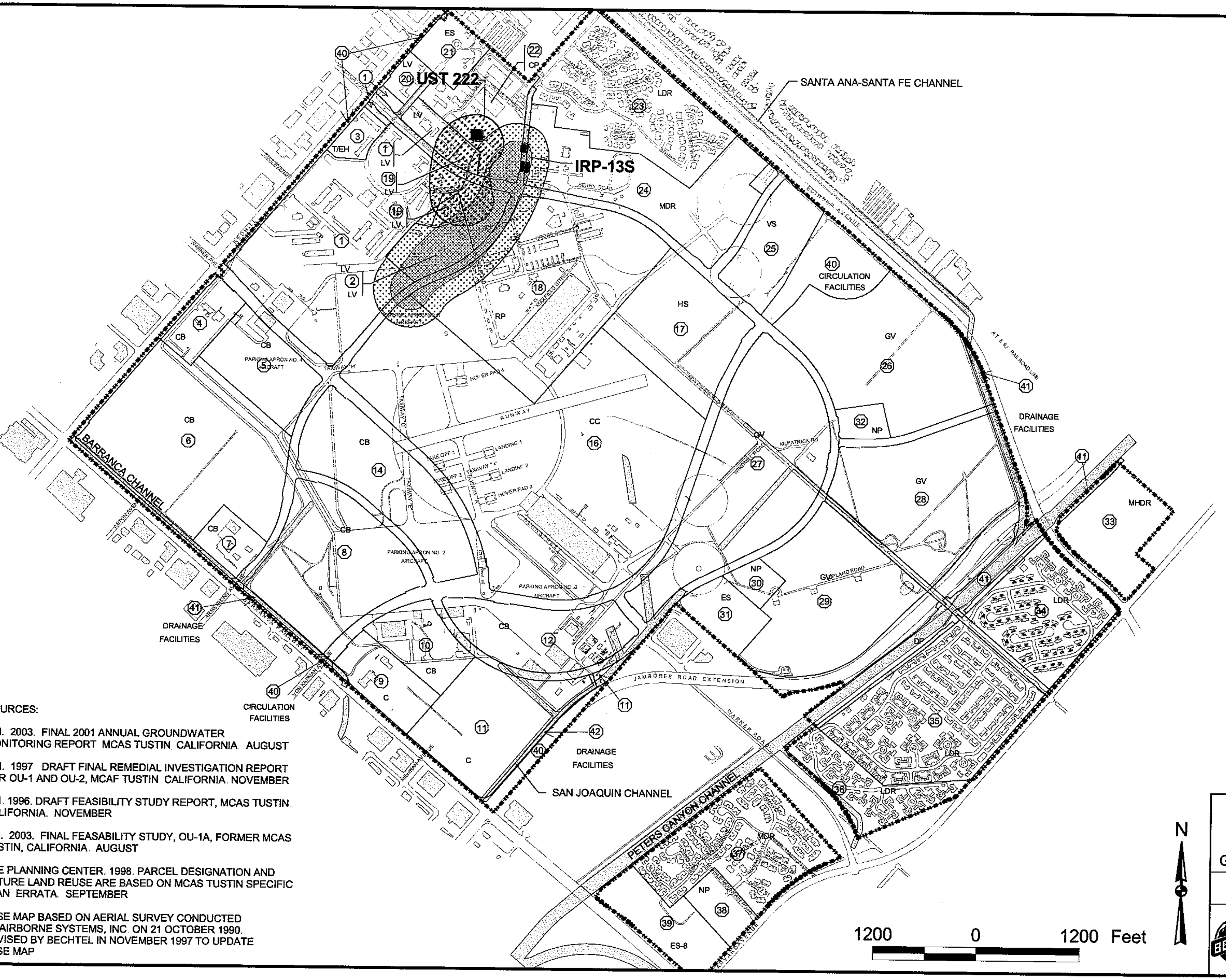
An OMP that will be developed during the remedial design phase will establish the exact number and location of monitoring wells. It will also outline sampling and analysis methods, periods and sampling frequency for each well, and major decision points to be made during monitoring (e.g., adding or removing wells, or changing sampling frequency or analytical parameters). The criteria for assessing the effectiveness of the remedial action and for shutoff will be developed during the remedial design phase and will be incorporated into the OMP.

10.7 EXTRACTION WELL SHUTDOWN CRITERIA

RAOs for OU-1A include reducing concentrations of VOCs in groundwater to levels consistent with remediation goals, or until the plume has stabilized, and preventing VOC migration beyond the current OU-1A plume boundaries. As a part of the selected remedy, the DON will operate hot spot groundwater extraction wells and hydraulic containment wells to meet these RAOs. The DON will evaluate groundwater monitoring and system performance data to 1) optimize the performance of the hot spot wells in reducing VOC contaminant mass in the central portion of the plumes and to determine when they may be shut down; and 2) optimize and verify the performance of the hydraulic containment wells in containing VOCs within their present boundaries and determine when they may be shut down (i.e., when the VOC plumes are stable or shrinking without active remediation). Groundwater monitoring and system performance data will be evaluated by the DON and reported to DTSC, RWQCB, and U.S. EPA.

10.7.1 Hot Spot Extraction Wells

For evaluation of hot spot extraction wells, if monitoring data indicate that these wells are no longer efficiently removing VOC mass (i.e., if an asymptotic condition is reached based on concentration versus time trend analysis) or if remediation goals have been achieved at the wells, they can be temporarily shut down and groundwater will be monitored for rebound in VOC concentrations. An "asymptotic condition" is defined as the point where the quantity of VOC mass removed over time has been reduced to a level at which continued reduction of VOCs is considered no longer technologically and/or economically feasible. After hot spot extraction wells are shut down, monitoring will continue for up to 2 years, and the data will be evaluated and reported to DTSC, RWQCB, and U.S. EPA. If monitoring data indicate a significant rebound in VOC concentrations in the hot spot portions of the plumes, the hot spot extraction wells will be restarted. Once asymptotic conditions for VOC mass removal are reached, the hot spot wells will be permanently shut down, subject to DTSC, RWQCB, and U.S. EPA concurrence.



LEGEND

- FORMER MCAS TUSTIN BOUNDARY
- ROAD OR PAVED AREA
- RAILROAD
- BUILDING OR STRUCTURE
- DRAINAGE DITCH
- FORMER MCAS TUSTIN REUSE PARCEL BOUNDARY
- AREA OF INSTITUTIONAL CONTROLS (INCLUDING GROUNDWATER EXTRACTION)
- EXTENT OF 1,2,3-TCP GROUNDWATER CONTAMINATION FROM IRP-13S
- EXTENT OF MTBE GROUNDWATER CONTAMINATION FROM UST 222
- LOCATION OF KNOWN OR POTENTIAL SOIL CONTAMINATION

NOTE:

1,2,3-TCP AND MTBE PLUMES ARE BASED ON WINTER 2001 GROUNDWATER DATA

SYMBOL	LAND USE
1	PARCEL NUMBER
40	CIRCULATION FACILITIES
41	DRAINAGE FACILITIES
C	COMMERCIAL
CB	COMMERCIAL BUSINESS
CC	COMMUNITY CORE
CP	COMMUNITY PARK
	EASEMENTS/ROADS
ES	ELEMENTARY SCHOOL (K-6)
ES-8	ELEMENTARY SCHOOL (K-8)
GV	GOLF VILLAGE
HS	HIGH SCHOOL
LDR	LOW DENSITY RESIDENTIAL
LV	EARNING VILLAGE
MDR	MEDIUM DENSITY RESIDENTIAL
MHDR	MEDIUM HIGH DENSITY RESIDENTIAL
NP	NEIGHBORHOOD PARK
RP	URBAN REGIONAL PARK
T/EH	TRANSITIONAL/EMERGENCY HOUSING
VS	VILLAGE SERVICES

SOURCES:

BEI. 2003. FINAL 2001 ANNUAL GROUNDWATER MONITORING REPORT MCAS TUSTIN CALIFORNIA AUGUST

BNI. 1997 DRAFT FINAL REMEDIAL INVESTIGATION REPORT FOR OU-1 AND OU-2, MCAF TUSTIN CALIFORNIA. NOVEMBER

BNI. 1996. DRAFT FEASIBILITY STUDY REPORT, MCAS TUSTIN, CALIFORNIA. NOVEMBER

BEI. 2003. FINAL FEASABILITY STUDY, OU-1A, FORMER MCAS TUSTIN, CALIFORNIA AUGUST

THE PLANNING CENTER. 1998. PARCEL DESIGNATION AND FUTURE LAND REUSE ARE BASED ON MCAS TUSTIN SPECIFIC PLAN ERRATA. SEPTEMBER

BASE MAP BASED ON AERIAL SURVEY CONDUCTED BY AIRBORNE SYSTEMS, INC. ON 21 OCTOBER 1990. REVISED BY BECHTEL IN NOVEMBER 1997 TO UPDATE BASE MAP

Record of Decision/Remedial Action Plan

Figure 10-6

Approximate Extent of Contaminated Soil and Groundwater Within Scope of OU-1A Feasibility Study

Former MCAS Tustin, California

Bechtel Environmental, Inc.
CLEAN 3 Program

Date: 3/4/04
File No : 035L11168
Job No : 23818-035
Rev No : D

10.7.2 Hydraulic Containment Wells

For evaluation of the hydraulic containment system, the DON can propose a temporary shutdown of the system if monitoring data indicate that either of the following conditions has been met:

1. VOC concentrations in groundwater within (throughout) the present OU-1A plume boundaries reach remediation goals (Table 8-2)
2. the boundaries of the VOC plumes have stabilized (or are shrinking) and VOCs will not migrate beyond their present boundaries at concentrations exceeding remediation goals (this would require groundwater modeling)

Temporary shutdown will be subject to DTSC, RWQCB, and U.S. EPA concurrence. The groundwater monitoring program will continue for up to 2 years. If it is demonstrated in this period that VOCs in groundwater meet the remediation goals (Table 8-2), the parties agree that system operation will be shut down permanently.

If, during temporary shutdown of the hydraulic containment system, data from monitoring wells within the boundaries of the plumes indicate that VOC concentrations are rebounding to levels exceeding the remediation goals, the containment system will be restarted. The DON can then attempt to demonstrate through groundwater modeling that remaining VOCs exceeding remediation goals would reach the current OU-1A plume boundaries at concentrations equal to or less than the remediation goals. Groundwater modeling will be subject to DTSC, RWQCB, and U.S. EPA concurrence. If the boundaries of the plume are demonstrated to be stable or shrinking without active remediation, the DON can then propose a permanent shutdown of the hydraulic containment system, subject to DTSC, RWQCB, and U.S. EPA concurrence. Groundwater monitoring at OU-1A would continue to confirm that VOCs are approaching remediation goals and that the remedy is still effective. If monitoring and/or modeling data indicate that the plumes would not remain within their present boundaries, the system will be restarted and operated as needed.

If the first or second condition stated above could not be achieved, the DON will demonstrate that VOCs in groundwater have been removed to the extent technically and economically feasible by analyzing:

- whether the total mass removal is approaching asymptotic levels after temporary shutdown periods and appropriate system optimization,
- the additional cost of continuing to operate the system at concentrations approaching asymptotic mass levels, and
- whether discontinuing the system will significantly prolong the time to achieve remediation goals for groundwater.

The signatories to this ROD/RAP will jointly make the decision that the hydraulic containment system may be shut off permanently. Groundwater monitoring will continue until all portions of the plume achieve remediation goals or until monitoring and modeling demonstrate the existing plumes are stable (or shrinking) and will not migrate beyond their present boundaries.

10.8 RATIONALE FOR REMEDY SELECTION

The selected remedy provides the best balance with respect to the NCP evaluation criteria. Based on the information available at this time, the selected remedy offers:

- a high level of performance when assessed against the following NCP evaluation criteria: short-term effectiveness; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume; implementability; compliance with ARARs; and overall protection of human health and the environment; and
- a cost-effective means of accomplishing the RAOs for the site.

Table 10-3 summarizes the cost estimate for the selected remedy, including capital and O&M costs assumed to extend for 30 years. The assumed 30-year time frame does not necessarily reflect the duration of the O&M activities at the site; the discontinuation or extension of O&M activities will be determined based on the results of sampling designed to evaluate the effectiveness of remediation.

Another advantage of the selected remedy is its compatibility with current and future land use. The use of containment wells will inhibit migration of contaminated groundwater and minimize the area over which the institutional controls must be enforced. Risk assessment results under a residential scenario with institutional controls in place indicate that the institutional controls would be effective in protecting human health and allow for the reuse of existing and newly constructed buildings within the site boundary for OU-1A (BEI 2003b). Impact on the existing infrastructure at IRP-13S will also be minimized to the extent practicable provided that remedial action efforts are not compromised.

Some modifications to the selected remedy (e.g., locations and number of wells, pumping rates) may be necessary as a result of the remedial design and construction process. Detailed design specifications, performance evaluations, and schedule will be determined during the remedial design phase.

Table 10-3
Summary of Cost Estimate[a] for Alternative 7

Description	Capital Cost	O&M Costs Annual Average	O&M Costs 5th Year	Total Costs[b]
Engineering study/design/monitoring plan (3,200 hours @ $85.00/hour)	$272,000			$272,000
Removal of Source Materials				
Soil excavation and off-site disposal[c]	$371,000			$371,000
Install five extraction wells (two wells in each WBZ, one in plume hot spot)	$302,000			$302,000
Wells O&M (average 30 years)		$20,333		$610,000
Piping	$154,000			$154,000
Carbon adsorption treatment system	$16,000			$16,000
GAC unit O&M (average 30 years)		$17,033		$511,000
Electrical distribution	$47,000			$47,000
Monitoring and Reporting				
Install two monitoring wells	$26,000			$26,000
Performance monitoring (average 30 years) (includes sample collection, analysis, water levels)		$76,300		$2,289,000
Annual monitoring report[d]		$10,000		$240,000
5-year review			$26,000	$156,000
Total				**$4,994,000**
Contingency (20%)[e]				$999,000
Escalation (Base 01 January 2001)				$3,029,000
Total Cost				**$9,022,000**[f]
Net Present Value of Alternative 7 (2002 $'s)				**$4,266,000**

Notes:
- [a] see Appendix D of the FS (BEI 2003b) for cost estimate details; sums may not agree due to rounding
- [b] total costs reflect hot spot groundwater extraction for 6 years and hydraulic containment for 30 years; monitoring activities (annual and 5-year) continue for assumed 30-year project duration
- [c] costs for soil excavation and off-site disposal are comparable to costs for soil excavation and on-site thermal treatment and reuse; based on a reevaluation of the soil disposal component of the preferred remedy presented in the Proposed Plan, on-site thermal treatment was determined to be infeasible and was replaced by off-site disposal as discussed in Section 12 of this ROD/RAP
- [d] cost not incurred every 5th year
- [e] contingency and other indirect costs not incurred on studies, plans, and reports

(table continues)

Table 10-3 (continued)

Notes: (continued)

[f] capital costs could be reduced up to approximately 45 percent if components of the existing TCRA system (extraction and monitoring well installation, piping, electrical distribution, GAC treatment system) are incorporated into the final remedy

Acronyms/Abbreviations:

FS – feasibility study
GAC – granular activated carbon
O&M – operation and maintenance
RAP – remedial action plan
ROD – record of decision
TCRA – time-critical removal action
WBZ – water-bearing zone

Section 11
STATUTORY DETERMINATIONS

Under CERCLA, the DON's primary responsibility is to undertake remedial actions that achieve adequate protection of human health and the environment. Section 121 of CERCLA establishes several additional statutory requirements and preferences specifying that, when complete, the selected remedial action must comply with ARARs established under federal and state laws unless a statutory waiver is justified. The selected remedy also must be cost-effective and use permanent solutions and alternative treatment technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that, as their principal element, permanently and significantly reduce the volume, toxicity, or mobility of hazardous waste. The following sections discuss how the selected remedy meets these statutory requirements and preferences. Complete discussions are found in the OU-1A FS Report (BEI 2003b).

11.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

RAOs for OU-1A are concerned with limiting future contaminant migration and exposures to contaminated media and restoring the beneficial use of the groundwater. The selected remedy protects human health and the environment by preventing use of contaminated groundwater for domestic purposes until remediation is complete. Although groundwater is currently not used for potable purposes, contaminated groundwater is a potential future threat to human health if it is used for domestic purposes. Remediation of soil and groundwater will eliminate this threat over time; in the interim, hydraulic containment will limit VOC migration beyond the current OU-1A plume boundary, and institutional controls will prevent inadvertent exposure to VOCs at concentrations above remediation goals by controlling new well drilling and prohibiting the domestic use of untreated groundwater. Land-use restrictions will also be used during remediation to prevent disturbance of extraction and monitoring wells and equipment for treatment of groundwater.

There are no short-term threats associated with the selected remedy that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the remedy.

11.2 COMPLIANCE WITH ARARs

The selected remedy will comply with the substantive provisions of all ARARs. Section 121(e) of CERCLA, U.S.C. § 9621(e), states that no federal, state, or local permit is required for remedial actions conducted entirely on-site. Therefore, actions conducted entirely on-site must meet only the substantive, not the administrative, requirements of the ARARs. Any action conducted off-site is subject to the full requirements of federal, state, and local regulations. The chemical-, location-, and action-specific ARARs for the selected remedy for OU-1A are listed in Tables 11-1, 11-2, and 11-3, respectively, and discussed below.

Table 11-1
Chemical-Specific ARARs for Selected Remedy

Action/Requirement	Citation	ARAR[a] Determination	Comments
FEDERAL			
Safe Drinking Water Act, 42 U.S.C. § 300[b]			
National primary drinking water standards are health-based standards for public water systems (MCLs).	40 C.F.R. § 141.61(a)	Relevant and appropriate	The NCP defines MCLs as relevant and appropriate for groundwater determined to be a current or potential source of drinking water, in cases where MCLGs are not ARARs. MCLs are relevant and appropriate for Class II aquifers such as the Irvine Pressure Subbasin. The Santa Ana RWQCB has designated the Irvine Pressure Subbasin for municipal/domestic use (potential drinking water) in addition to other uses. These designations also apply to the shallow groundwater system at Former MCAS Tustin. Only the primary standards for organic chemicals (40 C.F.R. § 141.61[a]), specifically VOCs, are ARARs for this action. MCLs for inorganics specified in 40 C.F.R. § 141.11 and 40 C.F.R. § 141.62 are not identified as ARARs because these are not the result of activities that occurred at Former MCAS Tustin or IRP-13S.
Resource Conservation and Recovery Act[b]			
Definition of RCRA-characteristic hazardous waste	Cal. Code Regs. tit. 22, § 66261.100(a)(1), 66261.21, 66261.22(a)(1), 66261.23, and 66261.24(a)(1)	Applicable	VOC-affected soil and groundwater, which may be generated by excavation, during well construction or monitoring, or groundwater extraction at IRP-13S, are not RCRA-listed hazardous wastes and are unlikely to be RCRA-characteristic hazardous wastes. However, soil and groundwater will still be tested for hazardous waste characteristics at the point of generation. In addition, there is the potential for some of the spent carbon to exceed TCLP limits for TCE, making it a characteristic hazardous waste.

(table continues)

Table 11-1 (continued)

Action/Requirement	Citation	ARAR[a] Determination	Comments
Resource Conservation and Recovery Act[b] (continued)			
Groundwater protection standards: owners/operators of RCRA treatment, storage, or disposal facilities must comply with conditions in this section designed to assure that hazardous constituents entering the groundwater from a regulated unit do not exceed the concentration limits for COCs set forth under § 66264.94 in the uppermost aquifer underlying the waste management area.	Cal. Code Regs. tit. 22, § 66264.94(a)(1), (a)(3), (c), (d), and (e)	Relevant and appropriate	This is not applicable because IRP-13S is not a TSD facility. No RCRA-listed hazardous wastes were reported disposed at OU-1A, IRP-13S, and groundwater contamination did not result from release of RCRA-regulated waste. However, it is relevant and appropriate because the waste soil and groundwater proposed to be generated are similar in composition to hazardous waste, and constituents in soil may have been released or have the potential to be released to groundwater.
Clean Water Act of 1977, as Amended (33 U.S.C., ch. 26, §§ 1251–1387)			
Federal ambient water quality standards.	40 C.F.R. § 131.36 (NTR) and 40 C.F.R. § 131.38 (CTR)	Applicable	Federal water quality standards are applicable for the proposed discharge of treated groundwater to surface water.
STATE			
Department of Toxic Substances Control			
Definition of "non-RCRA hazardous waste."	Cal. Code Regs. tit. 22, § 66261.22 (a)(3) and (4), 66261.24(a)(2) to (a)(8), 66261.101(a)(1) and (a)(2), 66261.3(a)(2)(C), or 66261.3(a)(2)(F)	Applicable	Using the state definition for hazardous waste, groundwater extracted from OU-1A wells, soil removed during well construction, and spent carbon residuals are determined not to be listed non-RCRA hazardous waste but will be tested to determine whether they meet the criteria for characteristic non-RCRA hazardous waste. If the waste is found to be a characteristic non-RCRA hazardous waste, generator requirements are applicable.
State and Regional Water Quality Control Board			
Authorizes SWRCB and RWQCB to establish, in water quality control plans, beneficial uses and numerical and narrative standards to protect both surface and groundwater quality.	Cal. Water Code, div. 7, §§ 13241, 13243, 13263(a), 13269, and 13360 (Porter-Cologne Water Quality Act)	Applicable	The DON accepts the substantive provisions of §§ 13241, 13243, 13263(a), 13269, and 13360 of the Porter-Cologne Water Quality Act enabling legislation, as implemented through the beneficial uses, WQOs, waste discharge requirements, and promulgated policies of the Basin Plan for the Santa Ana Region as ARARs.

(table continues)

Table 11-1 (continued)

Action/Requirement	Citation	ARAR[a] Determination	Comments
State and Regional Water Quality Control Board (continued)			
Describes water basins in the Santa Ana region; establishes beneficial uses of ground and surface waters; establishes WQOs, including narrative and numerical standards; establishes implementation plans to meet WQOs and protect beneficial uses; and incorporates statewide water quality control plans and policies.	Comprehensive Water Quality Control Plan for the Santa Ana Basin 1995	Applicable	Substantive provisions of Chapters 2 through 4 are applicable. The beneficial uses for the Irvine Pressure Subbasin designated in the WQCP are municipal/domestic use (potential drinking water), agricultural supply, industrial service supply, and industrial process supply. These uses also apply to the shallow groundwater system at Former MCAS Tustin. The WQOs and waste discharge requirements are applicable for groundwater cleanup and discharge to surface water.
Incorporated into all regional board basin plans. Designates all ground and surface waters of the state as drinking water except where the TDS is greater than 3,000 ppm, the well yield is less than 200 gpd from a single well, the water is a geothermal resource or in a water-conveyance facility, or the water cannot reasonably be treated for domestic use by either best management practices or best economically achievable treatment practices.	SWRCB Res. No. 88-63 (Sources of Drinking Water Policy)	Applicable	Substantive provisions are ARARs. The WQCP currently identifies the Irvine Pressure Subbasin and the overlying shallow groundwater at Former MCAS Tustin as a source of drinking water.
Establishes the policy that high-quality waters of the state "shall be maintained to the maximum extent possible" consistent with the "maximum benefit to the people of the State." It provides that whenever the existing quality of water is better than that required by applicable water quality policies, such existing high-quality water will be	Statement of Policy With Respect to Maintaining High Quality of Waters in California, SWRCB Res. 68-16	Applicable	This is not an ARAR for determining groundwater cleanup standards, although it is applicable for discharges to surface water, including discharges of treated groundwater in remedial actions (see action-specific ARARs Section 11.2.3.2).

(table continues)

Table 11-1 (continued)

Action/Requirement	Citation	ARAR[a] Determination	Comments
State and Regional Water Quality Control Board (continued)			
maintained until it has been demonstrated to the state that any change will be consistent with maximum benefit to the people of the state, will not unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than that prescribed in the policies. It also states that any activity that produces or may produce a waste or increased volume or concentration of waste and that discharges or proposes to discharge to existing high-quality waters will be required to meet waste-discharge requirements that will result in the best practicable treatment or control of the discharge.			
Substantive provisions of the ISWP provide the method for calculating effluent limitations and determining whether they are required.	Policy for implementation of Toxic Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (Phase 1 of the ISWP and the Enclosed Bays and Estuaries Plan [2000])	Applicable	Substantive provisions are applicable for the proposed discharge to surface water. This policy implements the federal NTR and CTR criteria for TCE.

Notes:

[a] where MCLs were not available, chemical-specific concentrations used to establish remediation goals may be based upon the following:

- human health risk-based concentrations (40 C.F.R. § 300.430[e][2][I][A][1] and [2])
- ecological risk-based concentrations (40 C.F.R. § 300.430 [e][2][I][G])
- practical quantitation limits of contaminants (40 C.F.R. § 300 430[e][2][I][A][3]);

many potential action-specific ARARs contain chemical-specific limitations and are addressed in the action-specific ARAR tables

(table continues)

Table 11-1 (continued)

Notes: (continued)

[b] statutes and policies and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the DON accepts the entire statute or policy as a potential ARAR; specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs

Acronyms/Abbreviations:

ARAR – applicable or relevant and appropriate requirement
Cal. Code Regs. – *California Code of Regulations*
Cal. Water Code – California Water Code
C.F.R. – *Code of Federal Regulations*
ch. – chapter
COC – chemical of concern
CTR – California Toxics Rule
div. – division
DON – Department of the Navy
gpd – gallons per day
IRP – Installation Restoration Program
ISWP – Inland Surface Waters Plan
MCAS – Marine Corps Air Station
MCL – maximum contaminant level
MCLG – maximum contaminant level goal
NCP – National Oil and Hazardous Substances Pollution Contingency Plan
NPDES – National Pollution Discharge Elimination System
NTR – National Toxics Rule
OU – operable unit
ppm – parts per million
RCRA – Resource Conservation and Recovery Act
Res. – resolution
RWQCB – (California) Regional Water Quality Control Board
§ – section
SWRCB – (California) State Water Resources Control Board
TCE – trichloroethene
TCLP – toxicity characteristic leaching procedure
TDS – total dissolved solids
tit. – title
TSD – treatment, storage, and disposal
U.S.C. – *United States Code*
VOC – volatile organic compound
WQCP – water quality control plan
WQO – water quality objective

Table 11-2
Location-Specific ARARs for Selected Remedy

Location/Requirement	Citation	ARAR Determination	Comments
FEDERAL			
Archaeological and Historical Preservation Act*			
Construction within area where action may cause irreparable harm, loss, or destruction of significant artifacts requires data recovery and preservation.	Substantive requirements of 36 C.F.R. § 65, 40 C.F.R. § 6.301(c), 16 U.S.C. § 469–469c-1	Relevant and appropriate	Extensive surveys at Former MCAS Tustin indicate that the OU-1A plumes do not underlie any culturally sensitive areas. SHPO and USACE have recommended no further assessment work for prehistoric or archaeological resources. Fossils have been identified at Former MCAS Tustin, but no impacts are expected from OU-1A remedial actions because construction grading is not planned as part of the remedial action. If fossils are identified during limited trenching, a PRMP could be implemented.
Archaeological Resources Protection Act of 1979, as Amended*			
Prohibits unauthorized excavation, removal, damage, alternation, or defacement of archaeological resources located on public lands unless such action is conducted pursuant to a permit.	Pub. L. No. 96-95 16 U.S.C. § 470aa–470mm	Applicable	Substantive provisions are considered applicable. Permits themselves are considered administrative in nature and are not required for on-site CERCLA actions. See comment under Archaeological and Historical Preservation Act.

Note:
* statutes and policies and their citations are provided as headings to identify general categories of potential ARARs for the convenience of the reader; listing the statutes and policies does not indicate that the DON accepts the entire statute or policy as a potential ARAR; specific potential ARARs are addressed in the table below each general heading; only substantive requirements of the specific citations are considered potential ARARs

Acronyms/Abbreviations:
ARAR – applicable or relevant and appropriate requirement
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
C.F.R. – *Code of Federal Regulations*
DON – Department of the Navy
MCAS – Marine Corps Air Station
OU – operable unit
PRMP – Paleontological Resources Management Plan
Pub. L. No. – Public Law number
§ – section
SHPO – State Historic Preservation Office
USACE – United States Army Corps of Engineers
U.S.C. – *United States Code*

Table 11-3
Action-Specific ARARs for Selected Remedy

Action/Requirement	Citation	ARAR Determination	Comments
FEDERAL			
Resource Conservation and Recovery Act, 42 U.S.C. § 6901 et seq.*			
Person who generates waste shall determine whether it is a hazardous waste.	Cal. Code Regs. tit. 22, §§ 66262.10(a), 66262 11, and 66264.13(a) and (b)	Applicable	Applicable for any operation generating waste, including extracted groundwater, soil cuttings from well installation, trench spoils, excavated soils, and treatment residuals such as spent GAC. The determination of whether materials are RCRA hazardous will be made when the wastes are generated.
On-site hazardous waste accumulation is allowed for up to 90 days as long as the waste is stored in containers or tanks, on drip pads, or inside buildings, and is labeled and dated, etc.	Cal. Code Regs. tit. 22, § 66262.34	Applicable	Applicable for any operation where hazardous waste is generated and transported. The determination of whether waste is hazardous will be made at the time of generation.
Requires that owners/ operators of a RCRA surface impoundment, waste pile, land-treatment unit, or landfill conduct a monitoring and response program for each regulated unit.	Cal. Code Regs. tit. 22, § 66264.91 (a) and (c), except as it cross-references permit requirements	Relevant and appropriate	Relevant and appropriate for IRP-13S Not applicable because this site is not a regulated unit. Table 8-1 identifies chemicals of concern at OU-1A.
Requires that a groundwater monitoring system be established and provides requirements the system must meet.	Cal. Code Regs. tit. 22, § 66264.97 (b) and (e)(1)–(5)	Relevant and appropriate	Relevant and appropriate for IRP-13S. Not applicable because this site is not a regulated unit. A groundwater monitoring plan will be developed during the remedial design phase.
Requires that the owner or operator of a regulated unit develop a detection monitoring program that will provide reliable indication of a release.	Cal. Code Regs. tit 22, § 66264.98	Relevant and appropriate	Relevant and appropriate for IRP-13S. Not applicable because this site is not a regulated unit. A groundwater monitoring plan will be developed during the remedial design phase.
Provides requirements for a corrective action program for a regulated unit.	Cal. Code Regs. tit 22, § 66264.100 (a) and (b)	Relevant and appropriate	Relevant and appropriate for IRP-13S Not applicable because this site is not a regulated unit. A groundwater monitoring plan will be developed during the remedial design phase.

(table continues)

Table 11-3 (continued)

Action/Requirement	Citation	ARAR Determination	Comments
Resource Conservation and Recovery Act, 42 U.S.C. § 6901 et seq.* (continued)			
In order to prevent release of hazardous waste or hazardous constituents to the environment, tank systems, including piping at ancillary equipment, shall have secondary containment (e.g., double-walled piping), meeting the requirements of Cal. Code Regs. tit. 22, § 66264.193 (b) and (c).	Cal. Code Regs. tit. 22, § 66264.193 (a), (b), (c), and (f)	Applicable	Applicable in the event that groundwater from extraction-well locations near the center of the OU-1A plumes exceeds the TCLP limits for TCE. The DON would comply with these requirements by using double-walled conveyance piping to transport untreated groundwater exceeding TCLP limits from the wellhead to the entrance point of the treatment system.
STATE			
Clean Air Act*			
Standard for approving permits. Equipment, the use of which may cause the issuance of air contaminants or the use of which may eliminate, reduce, or control the issuance of air contaminants, is so designed, controlled, or equipped with such air pollution control equipment that it may be expected to operate without emitting air contaminants.	SCAQMD Rule 212 (approved into SIP 04 February 1996)	Relevant and appropriate	CERCLA actions are exempt from local permit requirements. Substantive provisions are relevant and appropriate for the groundwater-treatment alternatives using vacuum-enhanced groundwater extraction.
Dust or fumes, including lead or lead compounds, may not be discharged to the atmosphere in amounts that exceed standards during any 1-hour period.	SCAQMD Rules 403 (approved into SIP 17 February 2000) and 405 (approved 02 September 1998)	Applicable	Fugitive dust emissions are expected from excavation and waste soil handling. Measures will be taken to control dust emissions.
Particulate matter from any source may not be discharged to the atmosphere in excess of 0.1 grain per cubic foot (0.230 milligrams per cubic meter) of particulate matter in gas calculated as dry gas at standard conditions.	SCAQMD Rule 404 (approved into SIP 02 September 1998)	Applicable	Fugitive dust emissions are expected from excavation and waste soil handling. Measures will be taken to control dust emissions.

(table continues)

Table 11-3 (continued)

Action/Requirement	Citation	ARAR Determination	Comments
California Civil Code			
Provides conditions under which land-use restrictions will apply to successive owners of land.	Cal. Civ. Code § 1471	Relevant and appropriate	Generally, Cal. Civ. Code § 1471 allows an owner of land to make a covenant to restrict the use of land for the benefit of a covenantee. The covenant runs with the land to bind successive owners, and the restrictions must be reasonably necessary to protect present or future human health or safety or the environment as a result of the presence on the land of hazardous materials, as defined in section 25260 of the California Health and Safety Code. Substantive provisions are the following general narrative standard: "to do or refrain from doing some act on his or her own land . . . where (c) Each such act relates to the use of land and each such act is reasonably necessary to protect present or future human health or safety or the environment as a result of the presence of hazardous materials, as defined in Section 25260 of the California Health and Safety Code." This narrative standard would be implemented through incorporation of restrictive covenants in the deed and Covenant to Restrict Use of Property at the time of transfer
California Health and Safety Code			
Allows DTSC to enter into an agreement with the owner of a hazardous waste facility to restrict present and future land uses.	Cal. Health & Safety Code § 25202.5	Relevant and appropriate	The substantive provisions of Cal. Health & Safety Code § 25202.5 are the general narrative standards to restrict "present and future uses of all or part of the land on which the . . . facility . . . is located . . . ."
Provides a streamlined process to be used to enter into an agreement to restrict specific use of property.	Cal. Health & Safety Code §§ 25222.1 and 25355.5(a)(1)(C)	Relevant and appropriate	Generally, Cal. Health & Safety Code §§ 25222.1 and 25355.5(a)(1)(C) provides the authority for the Department of Toxic Substances Control to enter into voluntary agreements with land owners to restrict the use of property. The agreements

(table continues)

Table 11-3 (continued)

Action/Requirement	Citation	ARAR Determination	Comments
California Health and Safety Code (continued)			
			run with the land restricting present and future uses of the land. The substantive requirements of the following Cal. Health & Safety Code § 25222.1 provisions are "relevant and appropriate": (1) the general narrative standard: "restricting specified uses of the property . . ." and (2) ". . . the agreement is irrevocable, and shall be recorded by the owner, . . as a hazardous waste easement, covenant, restriction or servitude, or any combination thereof, as appropriate, upon the present and future uses of the land." The substantive requirements of the following Cal. Health and Safety Code 25355.5(a)(1)(C) provisions are "relevant and appropriate": ". . . execution and recording of a written instrument that imposes an easement, covenant, restriction, or servitude, or combination thereof, as appropriate, upon the present and future uses of the land."
Provides processes and criteria for obtaining written variances from a land-use restriction and for removal of the land-use restrictions.	Cal. Health & Safety Code §§ 25233(c) and 25234	Relevant and appropriate	Cal. Health & Safety Code § 25233(c) sets forth "relevant and appropriate" substantive criteria for granting variances based upon specified environmental and health criteria. Cal. Health & Safety Code § 25234 sets forth the following "relevant and appropriate" substantive criteria for the removal of a land-use restriction on the grounds that ". . the waste no longer creates a significant existing or potential hazard to present or future public health or safety."
Requirements for land-use covenants	Cal. Code Regs. tit. 22, § 67391.1	Relevant and appropriate	Cal. Code Regs. tit. 22 § 67391.1 provides for a land-use covenant to be executed and recorded when remedial actions are taken and hazardous substances will remain at the property at concentrations that are unsuitable for unrestricted use of the land. The

(table continues)

Table 11-3 (continued)

Action/Requirement	Citation	ARAR Determination	Comments
California Health and Safety Code (continued)			
			substantive provisions of this regulation have been determined to be "relevant and appropriate" state ARARs by the DON.
South Coast Air Quality Management District			
No person shall discharge into the atmosphere from any single source of emissions any air contaminant for more than 3 minutes in any 60-minute period that is as dark as or darker than number 1 on the Ringelmann chart.	SCAQMD Rule 401(b)(1)(A)	Applicable	Fugitive dust emissions are expected from excavation and waste soil handling. Dust-suppression measures will be taken to control dust emissions
State and Regional Water Quality Control Board			
Establishes the policy that high-quality waters of the state "shall be maintained to the maximum extent possible" consistent with the "maximum benefit to the people of the State." It provides that whenever the existing quality of water is better than that required by applicable water quality policies, such existing high-quality water will be maintained until it has been demonstrated to the state that any change will be consistent with maximum benefit to the people of the state, will not unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than that prescribed in the policies. It also states that any activity that produces or may produce a waste or increased volume or concentration of waste and that discharges or proposes to	Statement of Policy With Respect to Maintaining High Quality of Waters in California, SWRCB Res. 68-16	Applicable	The DON acknowledges that SWRCB Res. 68-16 is an action-specific state ARAR for discharge of treated groundwater by storm drain to surface water of Peters Canyon Channel at Former MCAS Tustin. The selected alternative will comply with SWRCB Res. 68-16 by meeting the substantive provisions of NPDES Permit No. CAG918001 Compliance with the substantive provisions of this permit will assure that discharge of treated groundwater will not change or increase the concentrations of chemicals already allowed to be discharged to city of Tustin storm drains. Therefore, the selected alternative will not degrade the existing quality of the receiving downstream surface water bodies and will comply with the antidegradation provisions of SWRCB Res 68-16.

(table continues)

Table 11-3 (continued)

Action/Requirement	Citation	ARAR Determination	Comments
State and Regional Water Quality Control Board (continued)			
discharge to existing high-quality waters will be required to meet waste-discharge requirements that will result in the best practicable treatment or control of the discharge.			

Note:
- * statutes and policies and their citations are provided as headings to identify general categories of potential ARARs; specific potential ARARs are addressed in the table below each general heading

Acronyms/Abbreviations:

ARAR – applicable or relevant and appropriate requirement
Cal. Civ. Code – *California Civil Code*
Cal. Code Regs. – *California Code of Regulations*
Cal. Health & Safety Code – *California Health and Safety Code*
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
DON – Department of the Navy
DTSC – (California Environmental Protection Agency) Department of Toxic Substances Control
GAC – granular activated carbon
IRP – Installation Restoration Program
MCAS – Marine Corps Air Station
NPDES – National Pollutant Discharge Elimination System
OU – operable unit
RCRA – Resource Conservation and Recovery Act
Res. – resolution
§ – section
SCAQMD – South Coast Air Quality Management District
SIP – site implementation plan
SWRCB – State Water Resources Control Board
TCE – trichloroethene
TCLP – toxicity characteristic leaching procedure
tit. – title
U.S.C. – *United States Code*

11.2.1 Chemical-Specific ARARs

Chemical-specific ARARs are health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, establish the allowable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. If a chemical has more than one remediation goal, the most stringent level has been identified as an ARAR for this remedial action. The selected remedial action can be implemented to comply with chemical-specific ARARs.

Chemical-specific ARARs have been identified for groundwater, soil, and surface water. Groundwater is a medium of concern at IRP-13S; although shallow groundwater is not a potential source of drinking water, it contributes to the underlying aquifer, which is designated for beneficial use. Soil is not a direct threat to human health or the environment, but some soil hot spots have contaminant levels that could threaten groundwater. Surface water is not a medium of concern. However, chemical-specific ARARs have been identified for this medium because the selected remedy includes on-site discharge of treated groundwater that ultimately enters Peters Canyon Channel.

The substantive provisions of the following requirements were identified as the most stringent of the potential federal and state groundwater ARARs for remedial actions at IRP-13S:

- Water Quality Control Plan (WQCP) for the Santa Ana Region, 1995 (specifying water quality objectives [WQOs], beneficial use, waste discharge limitations)
- federal MCLs listed in the Safe Drinking Water Act (SDWA)
- RCRA groundwater protection standards in Cal. Code Regs. tit. 22, § 66264.94(a)(1), (a)(3), (c), (d), and (e)

The most stringent of these are the RCRA groundwater protection standards and Cal. Code Regs. tit. 22, § 66264.94 requirements to restore affected groundwater to background conditions, if possible, or else attain the best water quality that is technically and economically feasible. These requirements also address the soil threat to groundwater at § 66264.94(d)(1).

The DON has determined that the substantive provisions of Cal. Code Regs. tit. 22, § 66264.94(a)(1), (a)(3), (c), (d), and (e) constitute relevant and appropriate federal ARARs for groundwater. These provisions are considered a federal ARAR because this requirement was approved by U.S. EPA in its 23 July 1992 authorization of the state of California's RCRA program and is federally enforceable. The state of California disagrees with the DON; this regulation is a part of the state's authorized hazardous waste control program, so the state contends that the regulation is a state ARAR and not a federal ARAR. See 55 *Federal Register* (Fed. Reg.) 8765 (08 March 1990), and *United States v. State of Colorado*, 990 F 2d 1565 (1993).

In addition to ARARs for groundwater, the substantive provisions of the following requirements were identified as the most stringent chemical-specific ARARs for discharge of treated groundwater to Peters Canyon Channel:

- WQCP for the Santa Ana Region, 1995 (specifying WQOs, beneficial use, waste discharge limitations)
- Federal Water Quality Standards at 40 C.F.R. § 131.36 and 131.38 (referred to as the National Toxics Rule [NTR] and the California Toxics Rule [CTR], respectively)
- Inland Surface Waters Plan (ISWP)

Discussions of chemical-specific ARARs for groundwater and surface water follow.

11.2.1.1 GROUNDWATER CLASSIFICATION

Under SDWA and RCRA, a significant issue in identifying ARARs for groundwater is whether the groundwater can be classified as a source of drinking water. The U.S. EPA groundwater policy set forth in the NCP preamble uses the system in the U.S. EPA Guidelines for Groundwater Classification under the U.S. EPA Groundwater Protection Strategy (NCP, 55 Fed. Reg. 8752–8756). Under this policy, groundwater is classified in one of three categories (Class I, II, or III) based on ecological importance, its ability to be replaced, and vulnerability. Class I is irreplaceable groundwater currently used by a substantial population or groundwater that supports a vital habitat. Class II consists of groundwater currently used or that might be used as a source of drinking water in the future. Class III is groundwater that cannot be used for drinking water because of its unacceptable quality (e.g., high salinity or widespread naturally occurring contamination) or insufficient quantity. The U.S. EPA guidelines define Class III as groundwater with TDS concentrations over 10,000 mg/L. The aquifer underlying Former MCAS Tustin is classified as a Class II aquifer and is designated by RWQCB as a potential source of drinking water, along with other beneficial uses such as agricultural and industrial.

11.2.1.2 SAFE DRINKING WATER ACT

MCLs under the SDWA are potential relevant and appropriate requirements for aquifers with Class I and II characteristics and, therefore, are potential federal ARARs. The point of compliance for MCLs under the SDWA is at the tap. For CERCLA remedies, however, U.S. EPA indicates that MCLs should be attained throughout the contaminated plume, or at and beyond the edge of the waste management area when the waste is left in place (55 Fed. Reg. 8753). In accordance with the RAOs, it is the DON's intent to restore potential beneficial uses of the shallow aquifer underlying Former MCAS Tustin with regard to VOCs. The DON does not intend to establish a point of compliance for this remedial action.

The primary federal MCL for TCE that is an ARAR for the remedial action at OU-1A is set forth in 40 C.F.R. § 141.61(a) (Maximum Contaminant Levels for Organic Chemicals). MCLs for inorganics are not ARARs for OU-1A because there is no evidence that exceedances for these chemicals are caused by site-related activities. The primary state MCL for TCE set forth in Cal. Code Regs. tit. 22, § 64444 is not an ARAR for OU-1A because it is the same as, not more stringent than, the federal MCL. No federal or state MCL has been set forth for 1,2,3-TCP.

11.2.1.3 RCRA GROUNDWATER PROTECTION STANDARDS

Cal. Code Regs. tit. 22, § 66264.94 states that concentration limits for RCRA groundwater protection standards are set for RCRA-regulated units. These regulations provide that compounds must not exceed their background levels in groundwater or some higher concentration limit set as part of the corrective action program. A limit greater than background may be approved if the owner can demonstrate that it is not technologically or economically feasible to achieve the background value and that the constituent at levels below the concentration limit will not pose a hazard to human health or the environment. A concentration limit greater than background must never exceed other applicable statutes or standards such as MCLs established under the federal SDWA (Cal. Code Regs. tit. 22, § 66264.94[e]).

RCRA groundwater protection standards are applicable only for regulated units managing hazardous wastes. These standards are not applicable to IRP-13S because this site does not contain a RCRA waste management unit and the VOC-affected groundwater and soil to be addressed by this remedial action are not RCRA-listed hazardous wastes. However, these standards are considered relevant and appropriate because they address circumstances and contaminants similar to those encountered in the plume at and downgradient of IRP-13S. Accordingly, the DON has determined that the RCRA groundwater protection standards are ARARs for this remedial action.

A discussion of the technical and economic infeasibility of remediating groundwater to background is presented in the OU-1A FS Report (BEI 2003b). This document was reviewed and accepted by U.S. EPA, DTSC, and RWQCB. Therefore, as provided for in Cal. Code Regs. tit. 22, § 66264.94, a concentration limit for TCE based on the MCL is considered a remediation goal for OU-1A. A risk-based remediation goal has been established for 1,2,3-TCP at OU-1A.

11.2.1.4 WATER QUALITY CONTROL PLAN (SURFACE WATER)

The DON accepts as state ARARs for surface water the substantive provisions in Chapters 2 through 4 of the WQCP for the Santa Ana River Basin (RWQCB 1995), including beneficial uses, WQOs, and waste discharge requirements. The beneficial uses for Peters Canyon Channel include intermittent recreation, warm freshwater habitat, and wildlife habitat. There are no numerical WQOs specific to this surface water body.

11.2.1.5 NATIONAL TOXICS RULE AND CALIFORNIA TOXICS RULE

On 22 December 1992, U.S. EPA promulgated federal water quality standards under the authority of the federal Clean Water Act (CWA) § 303(c)(4)(B), 33 U.S.C., Chapter (ch.) 26, § 1313, in order to establish water-quality standards required by the CWA where the state of California and other states had failed to do so (57 Fed. Reg. 60848 [1992]). These standards have been amended over the years in the *Federal Register* including the amendments of the NTR (60 Fed. Reg. 22228 [1995]). The water quality standards, as amended, are codified at 40 C.F.R. § 131.36. The water quality standards in 40 C.F.R. § 131.36(a) are applicable federal ARARs for discharge to surface water at Former MCAS Tustin.

On 18 May 2000, U.S. EPA promulgated a rule to fill a gap in California's water quality standards that was created in 1994 when a state court overturned the state's WQCPs that contained water quality criteria for priority toxic pollutants. The rule, commonly called the CTR, is codified at 40 C.F.R. § 131.38 and is applicable in the state of California for inland surface waters and enclosed bays and estuaries for all purposes and programs under the CWA. They are also applicable requirements for groundwater that discharges to surface water. The DON will use NPDES Permit No. CAG918001, as discussed in Section 11.2.1.7, to comply with NTR and CTR requirements.

11.2.1.6 INLAND SURFACE WATERS PLAN

The 2000 California State Water Resources Control Board (SWRCB) Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California has substantive provisions that have guidance for implementing the federal CTR requirements. The substantive requirements for determining whether an effluent limitation is required and the methodology for calculating the effluent limitation found in Sections 1.3 and 1.4 of the ISWP are applicable state ARARs for the proposed discharge of treated groundwater to Peters Canyon Channel. The DON will use NPDES Permit No. CAG918001, as discussed in the following Section 11.2.1.7, to comply with the substantive requirements of the ISWP.

11.2.1.7 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

RWQCB has indicated that it intends to issue an NPDES permit if the selected OU-1A remedial action includes surface water discharge.

The DON has determined that Section 121(e)(1) of CERCLA and the corresponding provision in the NCP (40 C.F.R. § 300.400[e][1]) apply to the discharge of treated groundwater resulting from the remediation of OU-1A and that an NPDES permit is, therefore, not required for that discharge. The DON intends to construct and operate the groundwater treatment system entirely on-site. The treated groundwater will be discharged to a nearby storm drain, which will transport the treated water and ultimately discharge it into waters of the United States at an off-site location. The U.S. EPA has consistently maintained that the off-site migration of extracted water that has been treated under the response action so that it complies with ARARs is consistent with the on-site permit exclusion in Section 121(e) of CERCLA and, therefore, does not constitute an off-site response action that requires an NPDES permit. (See *In the Matter of the Former Weldon Ordnance Works*, Weldon Springs, Missouri, Federal Facility Docket No. VII-90-F-0033, 01 November 1995.) The DON agrees with this interpretation of CERCLA and the NCP.

Legal counsel from the DON and RWQCB have communicated regarding RWQCB's requirements for regulation of discharges to surface waters under the NPDES and have "agreed to disagree" on this matter. The DON and RWQCB positions are documented in correspondence dated 27 December 2000 (DON 2000) and 26 January 2001 (RWQCB 2001). Although the subject of this correspondence is a site at MCAS El Toro, the respective positions of both parties are the same for Former MCAS Tustin OU-1A.

On 01 October 1996, the RWQCB originally adopted NPDES Permit No. CAG918001, General Groundwater Cleanup Permit, and most recently (2002) renewed the permit under Order No. R8-2002-0007. This permit applies to discharges of extracted and treated groundwater resulting from the cleanup of groundwater contaminated with petroleum hydrocarbons, solvents, and/or petroleum hydrocarbons mixed with lead and/or solvents. The DON will use the general permit to determine the substantive requirements and comply with federal and state ARARs identified for the discharge of groundwater proposed at OU-1A. The procedural and administrative provisions for obtaining permit coverage and fees are not ARARs.

If the RWQCB issues a site-specific NPDES permit for the surface discharge associated with the selected OU-1A, it would not be an ARAR for this action because it would not be considered of general applicability. However, by complying with the substantive provisions of the general permit, the DON will most likely comply with the permit that RWQCB issues for the site. Consistent with this agree-to-disagree compromise, the DON continues to maintain that any surface water discharge related to OU-1A remedial action is exempt from such permit requirements, but the DON agrees to use the substantive requirements of NPDES Permit No. CAG918001, General Groundwater Cleanup Permit, to assure compliance with the substantive provisions of the CWA, CTR, WQCP, and other federal and state ARARs identified for the discharge of treated groundwater to surface water.

11.2.1.8 STATE WATER RESOURCES CONTROL BOARD RESOLUTIONS 92-49 AND 68-16

The DON's Position Regarding SWRCB Resolutions 92-49 and 68-16

The DON and the state of California have not agreed whether SWRCB Res. 92-49 and Res. 68-16 are ARARs for the remedial action at IRP-13S. Therefore, this ROD/RAP documents each party's position but does not attempt to resolve the issue.

The DON recognizes that the key substantive requirements of Cal. Code Regs. tit. 22, § 66264.94 (and the identical requirements of Cal. Code Regs. tit. 23, § 2550.4 and Section III.G of SWRCB Res. 92-49) require cleanup to background levels unless such restoration proves to be technologically or economically infeasible and an alternative remediation goal will not pose a substantial present or potential hazard to human health or the environment. In addition, the DON recognizes that these provisions are more stringent than corresponding provisions of 40 C.F.R. § 264.94 and, although they are federally enforceable via the RCRA program authorization, they are also independently based on state law to the extent that they are more stringent than the federal regulations.

The DON has also determined that SWRCB Res. 68-16 is not a chemical-specific ARAR for determining remedial action goals, but is an action-specific ARAR for regulating discharged treated groundwater. The DON has determined that further migration of already contaminated groundwater is not a discharge governed by the language in Res. 68-16. More specifically, the language of SWRCB Res. 68-16 indicates that it is prospective in intent, applying to new discharges in order to maintain existing high-quality waters. It is not intended to apply to restoration of waters that are already degraded.

The DON's position is that SWRCB Res. 68-16 and Res. 92-49 and Cal. Code Regs. tit. 23, § 2550.4 do not constitute chemical-specific ARARs for groundwater for this remedial action because they are state requirements and are not more stringent than the federal ARAR provisions of Cal. Code Regs. tit. 22, § 66264.94. The NCP set forth in 40 C.F.R. § 300.400(g)(4) provides that only state standards more stringent than federal standards may be ARARs (see also CERCLA Section 121[d][2][A][ii] [42 U.S.C. § 9621(d)(2)(A)(ii)]).

The substantive technical standard in the equivalent state requirements (i.e., Cal. Code Regs. tit. 23, Division [div.] 3, ch. 15 and SWRCB Res. 92-49 and Res. 68-16) is identical to the substantive technical standard in Cal. Code Regs. tit. 22, § 66264.94. This section of Cal. Code Regs. tit. 22 will likely be applied in a manner consistent with equivalent provisions of other regulations, including SWRCB Res. 92-49 and Res. 68-16.

The DON acknowledges that SWRCB Res. 68-16 is a state ARAR for discharge of treated groundwater by storm drain to surface water of Peters Canyon Channel at Former MCAS Tustin. SWRCB Res. 68-16 is discussed in this context in Section 11.2.3.2. The selected alternative will comply with SWRCB Res. 68-16 by meeting the substantive provisions of NPDES Permit No. CAG918001. Compliance with the substantive portions of the permit would assure that discharge of treated groundwater would not change or increase the concentrations of chemicals already allowed to be discharged to city of Tustin storm drains. Therefore, the selected alternative would not degrade the existing quality of the receiving downstream surface water bodies, and it will comply with the antidegradation provisions of SWRCB Res. 68-16.

State of California's Position Regarding SWRCB Resolutions 92-49 and 68-16

The state does not agree with the DON determination that SWRCB Res. 92-49 and Res. 68-16 and certain provisions of Cal. Code Regs. tit. 23, div. 3, ch. 15 are not ARARs for groundwater for this response action. SWRCB has interpreted the term "discharges" in the *California Water Code* to include the movement of waste from soils to groundwater and from contaminated to uncontaminated water (SWRCB 1994). However, the state agrees that the proposed action would comply with SWRCB Res. 92-49 and Res. 68-16, and compliance with the Cal. Code Regs. tit. 22 provisions should result in compliance with the Cal. Code Regs. tit. 23 provisions. The state does not intend to dispute the ROD/RAP, but reserves its rights if implementation of the Cal. Code Regs. tit. 22 provisions is not as stringent as state implementation of Cal. Code Regs. tit. 23 provisions. Because the Cal. Code Regs. tit. 22 regulation is part of the state's authorized hazardous waste control program, it is also the state's position that Cal. Code

Regs. tit. 22, § 66264.94 is a state ARAR and not a federal ARAR (*United States v. State of Colorado*, 990 F.2d 1565 [1993]).

Conclusion

Whereas the DON and the state of California have not agreed on whether SWRCB Res. 92-49 and Res. 68-16 and Cal. Code Regs. tit. 23, § 2550.4 are ARARs for this remedial action, this ROD/RAP documents each of the parties' positions on the resolutions but does not attempt to resolve the issue.

11.2.1.9 REMEDIATION GOALS

Remediation goals for groundwater are set at health-based levels, reflecting current and potential use and exposure. COCs in groundwater at OU-1A are TCE and 1,2,3-TCP, with TCE exceeding federal and state MCLs. The remediation goal for TCE is based on federal and state MCLs. A groundwater remediation goal has been established for 1,2,3-TCP after consideration of the best available toxicological information on the drinking water health risk posed by 1,2,3-TCP, along with the limitations of current analytical methodology, since there are currently no federal or state MCLs for 1,2,3-TCP. The DON believes that the remediation goals for COCs in groundwater (Table 8-2) satisfy the intent of the NCP preamble and that U.S. EPA National Ambient Water Quality Criteria need not be considered ARARs for this groundwater remedial action.

The shallow groundwater at Former MCAS Tustin contains elevated TDS, nitrate, sulfate, and selenium, all of which result from sources unrelated to USMC operations. Cleanup of this groundwater to below background conditions is not required by SWRCB under the Porter-Cologne Act. Therefore, the success of Alternative 7 would not be measured by reductions in TDS or other inorganic constituents that are not site-related contaminants.

11.2.2 Location-Specific ARARs

Location-specific ARARs are restrictions on the concentrations of hazardous substances or on activities solely because they are in specific locations such as floodplains, wetlands, historic places, and sensitive ecosystems or habitats. The selected remedial action will be implemented to comply with location-specific ARARs.

The substantive provisions of the following requirements were identified as the most stringent of the potential federal and state location-specific ARARs for the remedial actions at IRP-13S:

- 40 C.F.R. § 6.301(c) (Archaeological and Historic Preservation Act [16 U.S.C. § 469–469c-1])
- Public Law No. 96-95 (Archaeological Resources Protection Act of 1979, as Amended [16 U.S.C. § 470aa–470mm])

Information on historical and cultural resources that could be impacted by the OU-1A remedial action was derived from a historical resources survey for Former MCAS Tustin conducted by Thirtieth Street Architects, Inc. (1993) as well as a literature and records search conducted by John Minch and Associates (1993a,b,c). Both of these studies were further evaluated in the Former MCAS Tustin Environmental Setting Report (Cotton/Beland/Associates, Inc. 1994).

The Archaeological and Historic Preservation Act of 1974 requires that potential impacts to federally funded projects involving significant scientific, prehistoric, historic, or archaeological data be identified and mitigated. Former MCAS Tustin was the focus of numerous prehistoric archaeological assessments dating from 1972 through the early 1990s. As a result, the open spaces within Former MCAS Tustin have been thoroughly examined for prehistoric resources (Cotton/Beland/Associates, Inc. 1994). These investigations culminated in the discovery of a single prehistoric archaeological site that was destroyed in 1971 during construction of two large concrete water tanks. The State Historic Preservation Office and the Los Angeles office of the USACE have both recommended no further assessment work in conjunction with prehistoric archaeological resources in any of the open-space areas within the station (John Minch and Associates 1993a,b).

Paleontological resources were also evaluated, and it was determined that potentially significant fossil deposits could be encountered during construction and grading activities at Former MCAS Tustin (John Minch and Associates 1993c). The resources most likely to be encountered include invertebrate and vertebrate fossils in Pleistocene and recent sediments between the land surface and a depth of approximately 280 feet bgs. In a study by John Minch and Associates (1993c), a recommendation was made for the preparation of a Paleontological Resources Management Plan (PRMP) detailing methodologies to be used for surveillance of construction grading activities as well as actions to be taken in the event that fossils are discovered. This study stated that construction-related impacts to potential paleontological resources at the station can be effectively mitigated if the recommendations of the PRMP are implemented in compliance with the Archaeological and Historic Preservation Act of 1974. Based on this finding, the Archaeological and Historic Preservation Act of 1974 constitutes a federal location-specific ARAR for remedial action at OU-1A.

The Archaeological Resources Protection Act of 1979, as amended, prohibits excavation of archaeological site resources located on public lands unless such action is conducted pursuant to a permit. Remedial actions conducted under CERCLA entirely "on-site" are not required to obtain permits for said actions. However, conducting the limited excavation and/or site alteration that may be necessary in accordance with the substantive requirements of a dig permit appropriate to the purpose would assure these remedial activities are in compliance with the Archaeological and Historic Preservation Act of 1974. The Archaeological Resources Protection Act of 1979, therefore, also constitutes a federal location-specific ARAR for remedial action at OU-1A.

11.2.3 Action-Specific ARARs

Action-specific ARARs are technology- or activity-based requirements or limitations for remedial activities and apply to particular remediation activities. The selected remedy, Alternative 7 from the FS, includes groundwater containment and hot spot removal of soil and groundwater. Excavated soil will be loaded into trucks for off-site disposal (with prior treatment, as necessary) at a state-certified treatment, storage, and disposal (TSD) facility. Imported clean fill will be used to fill the excavation. Extracted groundwater will be treated at an aboveground facility located near IRP-13S and then discharged to an on-site city of Tustin storm drain. Actions associated with the selected remedy that trigger ARARs at OU-1A include installation of extraction and monitoring wells; soil excavation; groundwater monitoring, extraction, and treatment by carbon filtration; and discharge of groundwater to surface water. Federal and state action-specific ARARs for these activities are discussed in the following subsections.

11.2.3.1 FEDERAL

Federal laws that give rise to potential ARARs for actions to be undertaken as part of the selected alternative include RCRA requirements for monitoring and for characterizing, managing, storing, treating, and disposing of hazardous waste. These regulations are discussed below.

RCRA

RCRA requirements for monitoring and for identification/characterization, management, storage, treatment, and disposal of hazardous wastes (soil cuttings, water generated in the course of installing monitoring and extraction wells, extracted groundwater, spent carbon) are federal action-specific ARARs identified for the selected alternative. Portions of the RCRA groundwater protection standards contained in Cal. Code Regs. tit. 22 are considered relevant and appropriate for the groundwater potentially impacted by the releases from OU-1A because the hazardous chemicals being addressed by this alternative are similar or identical to those found in RCRA hazardous wastes.

Based on a review of historical site information, manifests, storage records, and interviews with past employees, the DON has determined that soil, groundwater, and spent carbon at the OU-1A site would not be classified as RCRA-listed hazardous wastes. However, testing would still be required to classify these materials with respect to the RCRA hazardous waste characteristics. This determination will be made at the time the waste is generated. Because GAC filters will be transported off-site as they become spent and no on-site storage is proposed, GAC filters will not be addressed by ARARs, which are for on-site CERCLA activities. If spent GAC is shown by testing to also be RCRA-characteristic hazardous waste, then all applicable requirements will be complied with for off-site transportation and disposal. Soil cuttings, trench spoils, groundwater, and excavated soil are not expected to be RCRA-characteristic hazardous waste based on data collected during the RI. However, if testing at the time of waste generation indicates a hazardous waste, then the appropriate RCRA requirements in Table 11-3 for temporary storage and disposal would be ARARs.

Based on RI data and the modeling results presented in the OU-1A FS Report (BEI 2003b), the DON expects that the groundwater to be extracted under Alternative 7 would be below the RCRA-characteristic level (500 μg/L for TCE) for classification as D040 hazardous waste, with the exception of groundwater extracted from plume hot spots at IRP-13S. Further characterization of groundwater extracted from the shallow groundwater unit will be performed during the remedial design phase as well as during start-up of the treatment system. The purpose of this testing would be to confirm the DON's expectations regarding groundwater characteristics and to satisfy federal RCRA waste-classification requirements. If extracted groundwater is found to be RCRA characteristic waste, substantive RCRA requirements would apply from the individual wellheads with groundwater exceeding 500 µg/L TCE to the point at which the water no longer exhibits the characteristics of RCRA hazardous waste. The RCRA requirements will be met by using double-contained conveyance piping from the wellhead with groundwater exceeding 500 µg/L TCE to the entrance point of the treatment system.

A groundwater monitoring program will be developed during the remedial design phase. Substantive provisions of the following requirements are relevant and appropriate to the development and implementation of the monitoring program:

- groundwater monitoring and response (Cal. Code Regs. tit. 22, § 66264.91[a] and [c]), except as it cross-references permit requirements
- requirements for monitoring groundwater and surface water (Cal. Code Regs. tit. 22, § 66264.97[e])
- detection monitoring (Cal. Code Regs. tit. 22, § 66264.98)
- corrective-action program (Cal. Code Regs. tit. 22, § 66264.100[a] and [b])

These regulations are not applicable because IRP-13S is not a RCRA-regulated unit.

The DON plans to excavate soil within the vadose zone and upper confining layer of the first WBZ with TCE at concentrations greater than approximately 400 µg/kg. Groundwater modeling results indicate that soils left in place with TCE and/or 1,2,3-TCP at concentrations exceeding 400 and 100 µg/kg, respectively, would result in a continuing source of contamination to groundwater at concentrations exceeding the remediation goals established for these chemicals. Soils contaminated with 1,2,3-TCP at concentrations exceeding the excavation criteria of 100 µg/kg were not reported at the site (with one exception: one soil sample had a reported concentration of 160 µg/kg); therefore, soils targeted for excavation will be portions of the vadose zone and upper confining layer of the first WBZ with TCE at concentrations above 400 µg/kg. Soils with these contaminant concentrations are not subject to land disposal restrictions; therefore, treatment prior to disposal will not be required. Excavated soil will be loaded into trucks for off-site disposal at a state-certified TSD facility selected based on the waste characterization results. CERCLA ARARs do not pertain to off-site actions such as disposal (after treatment, if necessary); however, these actions are subject to applicable state regulatory program requirements. Because these state requirements are not CERCLA ARARs for on-site actions, they are not documented in this ROD/RAP, but will be identified and discussed in the work plan for the remedial design phase. The work plan will also state how the excavated waste will be contained, labeled, and transported for off-site disposal and which state-permitted TSD facility will be used. Only imported clean fill will be used to backfill the excavated area.

Waste soil and spent GAC are not anticipated to be classified as RCRA hazardous waste or stored for a significant period of time after generation. However, RCRA requirements for storage of hazardous waste for 90 days or less would be relevant and appropriate to the temporary accumulation of these wastes. In the unlikely event that storage of these wastes exceeds 90 days, the requirements of Cal. Code Regs. §§ 66264.34(d) and (e) and 66264.35 would become relevant and appropriate.

Clean Air Act

Desorbed and potentially carcinogenic VOCs may be emitted to the atmosphere under Alternative 7 after groundwater treatment by vapor-phase GAC. Requirements that have been incorporated in the SIP and are therefore considered to be federal ARARs for this action include substantive requirements of SCAQMD Rule 212, and for fugitive dust, Rules 403 and 404. Rules 403 and 404 regulate releases of dust and particulate matter that could occur during grading or excavation of soil. The DON will comply with these regulations by employing standard dust suppression measures such as wetting the soil during excavation and loading for off-site disposal.

11.2.3.2 STATE

State laws that give rise to potential ARARs for actions to be undertaken as part of the selected alternative include state requirements for characterizing non-RCRA hazardous waste; the WQCP waste-discharge requirements; SWRCB Res. 68-16 requirements for treated groundwater that is being discharged to surface water; and *California Civil Code* (Cal. Civil Code) and *California Health and Safety Code* requirements for implementing institutional controls. These regulations are discussed below.

RCRA

Waste streams generated in the course of implementing the selected alternative will be characterized with respect to state criteria for identification of non-RCRA hazardous waste. Materials that will be tested under this requirement are the soil cuttings and development water from installation of monitoring and extraction wells, trench spoils from construction of conveyance pipelines, extracted and treated groundwater, excavated soil from potential source removal, and spent GAC. Although not anticipated based on existing sample results, any waste exhibiting a characteristic of non-RCRA hazardous waste will be managed in accordance with the appropriate requirements of Cal. Code Regs. tit. 22, § 66264, already identified as federal ARARs in Section 11.2.3.1.

Water Quality Control Plan

Performance goals for treatment of extracted groundwater will be based on reducing TCE and 1,2,3-TCP to levels allowable for discharge to surface water. The proposed discharge would comply with the substantive provisions of the waste-discharge requirements and surface WQOs applicable to a city of Tustin storm drain, as established in the WQCP. These elements of the WQCP constitute state chemical-specific ARARs for Alternative 7 and were discussed previously in Section 11.2.1.

NPDES Permit

The discharge of treated water to surface water will need to comply with the ARARs identified in Section 11.2.1, Chemical-Specific ARARs. RWQCB intends to issue an NPDES permit if the selected OU-1A remedial action includes surface water discharge. The DON and RWQCB have "agreed to disagree" concerning the applicability of the permit exclusion of CERCLA Section 121(e). Consistent with this agree-to-disagree compromise, the DON continues to maintain that any surface water discharge related to OU-1A remedial action is exempt from such permit requirements, but the DON agrees to comply with the substantive requirements of the existing general permit as a means of assuring compliance with the substantive provisions of the WQCP and other state ARARs as provided by Section 121(d) of CERCLA.

State Water Resource Control Board Resolution 68-16

As stated in Section 11.2.1.8 and Table 11-1, the DON acknowledges that SWRCB Res. 68-16 is an action-specific state ARAR for discharge of treated groundwater by storm drain to surface water of Peters Canyon Channel at Former MCAS Tustin. The selected alternative will comply with SWRCB Res. 68-16 by meeting the substantive provisions of NPDES Permit No. CAG918001. Compliance with the substantive provisions of this permit will assure that discharge of treated groundwater will not change or increase the concentrations of chemicals already allowed to be discharged to city of Tustin storm drains. Therefore, the selected alternative will not degrade the existing quality of the receiving downstream surface water bodies and will comply with the antidegradation provisions of SWRCB Res. 68-16.

South Coast Air Quality Management District Regulations

The state requirement regulating dust generated during excavation consists of the substantive provisions of SCAQMD Rule 401. Rule 401 regulates releases of dust and particulate matter that could occur during grading or excavation of soil. The DON will comply with this rule by employing standard dust suppression measures.

California Civil Code Section 1471; California Health and Safety Code Sections 25202.5, 25222.1, 25233(c), 25234, 25355.5; and Cal. Code Regs. Tit. 22 Section 67391.1.

State statutes that have been accepted by the DON as ARARs for implementing institutional controls and entering into a Covenant to Restrict Use of Property with DTSC include substantive provisions of the Cal. Civ. Code § 1471 and the Cal. Health & Safety Code §§ 25202.5, 25222.1, 25233(c), 25234, and 25355.5. DTSC promulgated a regulation on 19 April 2003 regarding "Requirements for Land-Use Covenants" at Cal. Code Regs. tit. 22, § 67391.1. The substantive provisions of this regulation have been determined to be "relevant and appropriate" state ARARs by the DON.

The substantive provisions of Cal. Civ. Code § 1471 are the following general narrative standard: ". . . to do or refrain from doing some act on his or her own land . . . where . . . : (c) Each such act relates to the use of land and each such act is reasonably necessary to protect present or future human health or safety or the environment as a result of the presence on the land of hazardous materials, as defined in § 25260 of the Health and Safety Code." This narrative standard would be implemented through incorporation of restrictive environmental covenants in the deed at the time of transfer. These covenants would be recorded with the Covenant to Restrict Use of Property and run with the land.

The substantive provision of Cal. Health & Safety Code § 25202.5 is the general narrative standard to restrict "present and future uses of all or part of the land on which the . . . facility . . . is located . . . ." This substantive provision will be implemented by incorporation of restrictive environmental covenants in the Covenant to Restrict Use of Property at the time of transfer for purposes of protecting present and future public health and safety.

Cal. Health & Safety Code §§ 25222.1 and Cal. Health and Safety Code 25355.5(a)(1)(C) provide the authority for the state to enter into voluntary agreements to establish land-use covenants with the owner of property. The substantive requirements of the following Cal. Health & Safety Code § 25222.1 provisions are "relevant and appropriate": (1) the general narrative standard: "restricting specified uses of the property,...." and (2) "... the agreement is irrevocable, and shall be recorded by the owner, ...as a hazardous waste easement, covenant, restriction or servitude, or any combination thereof, as appropriate, upon the present and future uses of the land." The substantive requirements of the following Cal. Health & Safety Code § 25355.5(a)(1)(C) provisions are "relevant and appropriate": "....execution and recording of a written instrument that imposes an easement, covenant, restriction, or servitude, or combination thereof, as appropriate, upon the present and future uses of the land."

The DON will comply with the substantive requirements of Cal. Health & Safety Code §§ 25222.1 and 25355.5(a)(1)(C) by incorporating CERCLA use restrictions into the DON's deed of conveyance in the form of restrictive covenants under the authority of Cal. Civ. Code § 1471. The substantive provisions of Cal. Health & Safety Code §§ 25222.1 and 25355.5(a)(1)(C) may be interpreted in a manner that is consistent with the substantive provisions of Cal. Civ. Code § 1471. The covenants shall be recorded with the deed and run with the land.

Cal. Health & Safety Code § 25233(c) sets forth "relevant and appropriate" substantive criteria for granting variances from prohibited uses based upon specified environmental and health criteria. Cal. Health & Safety Code § 25234 sets forth the following "relevant and appropriate" substantive criteria for the removal of a land-use restriction on the grounds that "....the waste no longer creates a significant existing or potential hazard to present or future public health or safety."

In addition to being implemented through the Covenant to Restrict Use of Property between the DON and DTSC, the appropriate and relevant portions of Cal. Health & Safety Code §§ 25202.5, 25222.1, 25233(c), 25234, and 25355.5(a)(1)(C) and Cal. Civ. Code § 1471 shall also be implemented through the deed between the DON and the transferee.

U.S. EPA does not agree with the DON and DTSC that the sections of the Cal. Civ. Code and Cal. Health & Safety Code cited above are ARARs because they fail to meet the criteria for ARARs pursuant to U.S. EPA guidance (i.e., they are administrative, not substantive, requirements that establish a discretionary way to implement land-use restrictions). However, U.S. EPA agrees that the substantive provisions of the recently promulgated regulation (Cal. Code Regs. tit. 22, § 67391.1) providing for the execution of a land-use covenant between the DON and DTSC is a "relevant and appropriate" state ARAR. DTSC's position is that all of the state statutes and regulations referenced in this section are ARARs.

11.3 COST-EFFECTIVENESS

The selected remedy has been determined to provide overall effectiveness proportional to its costs; it is therefore considered cost-effective. The estimated net present-worth cost for this remedial action is approximately $4.3 million. Capital and O&M costs include costs associated with excavation and off-site disposal of contaminated soil and with construction and operation of the shallow groundwater containment and extraction wells and conveyance pipelines. Technologies included in Alternative 7 are readily implementable and have been widely used and demonstrated to be effective. The cost of the selected alternative, although higher than the cost of the no action alternative, represents a low-cost, effective, permanent solution for soil and groundwater remediation.

11.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES (OR RESOURCE RECOVERY TECHNOLOGIES) TO THE MAXIMUM EXTENT PRACTICABLE

The DON and the state of California have determined that the selected remedy represents the maximum extent practicable to which permanent solutions and alternative treatment technologies can be used cost-effectively at OU-1A. This alternative is protective of human health and the environment and complies with the ARARs for IRP-13S. VOC contaminants within groundwater and soil will be extracted and permanently destroyed or removed from the site area. Although some residual contamination may remain in groundwater, the concentration should not be high enough to present a risk to human health. The selected alternative is readily implementable using standard equipment and methods. Remediation of groundwater is expected to take several decades. In the meantime, the DON will protect human health through land-use restrictions prohibiting use of untreated groundwater for domestic purposes.

The most decisive factors in the selection of Alternative 7 are that this alternative will permanently reduce the toxicity and volume of VOC contaminants and will assist in restoration of the groundwater to its designated beneficial uses.

11.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

CERCLA Section 121(b) identifies a statutory preference for alternatives that use treatment to reduce the toxicity, mobility, or volume of contamination. The selected alternative complies with this requirement to the extent practicable.

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Section 12
DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for OU-1A, released for public comment in August 2003, identified Alternative 7, hydraulic containment with hot spot removal, as the preferred alternative for remediation of groundwater at IRP-13S. A component of the preferred alternative included on-site thermal treatment and reuse of excavated soil. Since the Proposed Plan was released, the feasibility of this soil disposal component of the preferred alternative was reevaluated based on new information and was found to be infeasible. The selected remedy presented in this ROD/RAP (Section 10) includes the off-site soil disposal component from Alternative 4 as a feasible replacement for the original on-site thermal treatment and reuse component.

The evaluation of on-site thermal treatment and reuse of soil in the FS assumed permits for this activity would be readily available, existing utilities could be used, and an existing on-site TDU would not require extensive pretesting. The recently conducted reevaluation of the soil disposal component considered the technical feasibility of permitting an on-site TDU, the current availability of utilities, and pretreatment requirements. The following conditions exist at the site that were not known during the FS or have changed since the FS.

- Permitting: Discussions with SCAQMD indicated that permitting an on-site TDU for VOCs could be prolonged based on difficulties in demonstrating the TDU would operate as designed and in assuring that no off-gassing of hazardous substances would occur. The DON's experience prior to the Proposed Plan included on-site treatment of soils that were not impacted by VOCs.
- Utilities: The DON previously owned utilities at Former MCAS Tustin, but these utilities were transferred to the city of Tustin in 2002. Since the transfer, natural gas lines previously used for an on-site TDU have been shut down by the city of Tustin. An alternate source of natural gas would therefore be required. Electrical and water utility systems were likewise transferred to the city of Tustin in 2002, and both these systems have been restricted in some capacity by the city of Tustin. Therefore, use of electricity and water would also need to be coordinated and contracted with the city of Tustin to support another on-site TDU.
- Pretreatment requirements: Prior to mobilizing an on-site TDU, pilot tests would be required to assist in the design of the full-scale system. The pilot tests would need to evaluate soil conditions, optimal temperature ranges, and additional treatment requirements. These tests would be necessary to address uncertainties about the treatment of soil and whether such an operation could be permitted.

Existing conditions at the site and additional permitting requirements contribute to determining that the on-site thermal treatment and reuse component is infeasible as the soil disposal component of the preferred alternative. Therefore, on-site thermal treatment and reuse have been replaced with off-site disposal as the soil disposal component of the selected remedy.

Off-site soil disposal was evaluated in the FS as a component in the screening process for remedial technologies. Off-site soil disposal was retained for further consideration and was included in two of nine alternatives evaluated in the FS (Alternatives 4 and 6). The detailed analysis of the nine remedial alternatives in the FS indicated Alternative 7 would be the preferred alternative. However, components of the other alternatives, including the off-site disposal component, were determined to be feasible for use in the selected remedy since they had all been fully evaluated in the FS and presented in the Proposed Plan.

The new information obtained for the on-site thermal treatment component rendered it infeasible, and another soil disposal component was required for the preferred alternative. In accordance with U.S. EPA guidance on the preparation of RODs, significant changes to the preferred alternative after release of the Proposed Plan and prior to signing of this ROD/RAP require documentation of and rationale for the changes. The change in the soil disposal component of the preferred alternative for OU-1A is reasonable because the off-site soil disposal component was fully evaluated in the FS, found to be feasible, and presented previously in the Proposed Plan under two alternatives.

The DON prepared a Fact Sheet that included a discussion of the proposed change to the soil disposal component for OU-1A. The Fact Sheet was issued to the public on 17 February 2004, and a 30-day public comment period was established to address any comments the DON received on the change. The change in the soil disposal component was also discussed at the RAB meeting on 24 February 2004. Oral and written comments from the public have been incorporated into the Responsiveness Summary for OU-1A. Based on the comments received and on discussions with the regulatory agencies, the change in the soil disposal component of the preferred alternative was incorporated into the selected remedy as presented in Section 10.

Section 13
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RESPONSIVENESS SUMMARY

RESPONSES TO COMMENTS
RECEIVED DURING THE PUBLIC COMMENT PERIOD

RESPONSIVENESS SUMMARY
FORMER MARINE CORPS AIR STATION – TUSTIN, CALIFORNIA
PROPOSED PLAN/DRAFT REMEDIAL ACTION PLAN FOR OPERABLE UNIT (OU) 1A

Comments Received During Public Meeting Held on 21 August 2003

Comments by: ***Don Zweifel, RAB Member***

Number	Comments	Responses
1	I've been to so many of these affairs. For nine years now I've done this at Tustin and El Toro. And I always feel that it seems that IT has forgotten – I'm talking about – I'm specifically talking about innovative technologies. I'm talking about BAT, as you know, the best available technologies. Well, you see there is such a thing as in situ bio remediation that we talked about this evening. So I would like to see more alternatives. I'd like to see nine alternatives, perhaps. I just don't feel that these alternatives are as comprehensive as they should be. And that's been my complaint since 1994, is that we need to have more alternatives, more options. That's critical, ladies and gentlemen. You can't – this is such a finite. I know they cost – I know we're talking about money. Or, Content, I'm sure will concur there's a factor of cost here. But, ladies and gentlemen, you've got to consider that there's IT out there, and there's some wonderful – There's some wonderful, new, innovative – new technologies out there that are very successful. And, yet, they're not addressed here. So I think the time has come to ask that we do consider a few more alternatives, at least two more. But I know maybe it's a bit late to ask this. But at the same time, I thought, well, perhaps you would decide to expand the number of alternatives. But I guess that's my greatest complaint, is that there are a BAT factor. And whether it's the best practical technology, whether it's a – I think what we're all seeking is BAT, that the EPA – you know, I'm sure – Maybe I should ask Jim Callian what he thinks about this too. Because we do – we do – There is also a best conventional technology. So I think that's what we're actually – Ladies and gentlemen, we're dealing here with BCT, the best conventional technology, good, old-fashioned, tried-and-true technology. And where's the innovativeness? The Navy's also erred on the side of caution. And I can understand that. But, yet, a time comes where we need to think proactively. We need to think creatively. Thank you.	<u>Response:</u> The Navy thanks Mr. Zweifel for his contributions to the Restoration Advisory Board for Former MCAS Tustin. The permeable iron wall represents an innovative technology that could perform very effectively in some applications, and was one of the nine remedial alternatives evaluated in detail for OU-1A. This technology survived the initial screening in the Feasibility Study (FS) process and was thoroughly evaluated as a remedial action alternative (Alternative 5). Unfortunately, the wall was found to be inappropriate for this particular site for several reasons. The permeable reaction wall would use reactive iron material placed in "curtains" installed at downgradient locations in positions perpendicular to groundwater flow such that groundwater would naturally pass through them and contamination would be removed. Because this alternative requires natural groundwater flow to transport VOC contamination through the walls, it would require a much longer time to achieve the cleanup goals in the shallow aquifer. In particular, significant contamination would remain after 30 years in upgradient portions of the sand layers in the first WBZ. This alternative was also determined to be the most expensive and least implementable because of the potential for fouling due to the elevated TDS concentrations in the shallow aquifer at MCAS Tustin. It was also rated low in implementability because there is only one experienced process vendor available to market this technology. During the CERCLA 5-year review process, the Navy will continue to evaluate the progress and effectiveness of the selected remedy. This evaluation will include the potential for optimizing the remedy by implementing additional remedial technologies that if/when they are developed and identified, could improve the efficiency of the remedy and/or shorten the time to achieve remediation goals, given the site-specific conditions encountered at OU-1A.

RESPONSE TO LETTERS
RECEIVED DURING THE PUBLIC COMMENT PERIOD

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Letters Received During Public Comment Period

Comments by: ***Michael Fernandez, Technical Outreach Services for Communities, Comment Form Dated September 5, 2003***

Number	Comments	Responses
1	Overall the Proposed Plan is very clear and well-written. I think the preferred remedy is appropriate and should be effective. I prefer a more aggressive approach to groundwater remediation and encourage DON to consider supplementing the hydraulic containment system with other methods such as enhanced bioremediation (reductive dechlorination).	**Response:** Thank you for your comment. During the CERCLA 5-year review process, the Navy will continue to evaluate the progress and effectiveness of the selected remedy. This evaluation will include the potential for optimizing the remedy by implementing additional remedial technologies that if/when they are developed and identified, could improve the efficiency of the remedy and/or shorten the time to achieve remediation goals, given the site-specific conditions encountered at OU-1A.